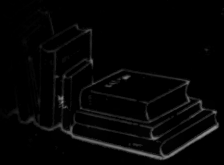
ABSTRACTS OF NORTH AMERICAN GEOLOGY



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ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

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ABSTRACTS

03759 **Adams, Richard M.; Joyner, Gerald.** Geophysical surveying, Chap. 7 *in* UnderSea Technology—Handbook, Directory, 1968: Arlington, Va., Compass Pubs., p. A51–A60, illus., 1968.

Modern geophysical oceanographic research originated because of mineral and petroleum search, and because academic and government activity has increased over the last 35 years to encompass wide areas of specialized research. Knowledge of the ocean bottom and near subbottom are important in acoustic wave study, and increased knowledge of the magnetosphere and Earth's gravitational field are also necessary. Survey vessels and system integration are described. Two examples are chosen to illustrate present marine geophysical ability. First the survey sponsored by the U.S. Naval Oceanographic Office in the eastern and central North Atlantic Ocean, and Mediterranean and Norwegian Seas are summarized, and the ships and their equipment and personnel are discussed and the data collection system described. As the second example, less detailed information is given on geophysical activities for commercial exploration.—ESL

Albee, A. L. *See* Bence, A. E. 03898

Albers, John P. *See* Stewart, John H. 03837

03558 **Ali, Syed A.; Weiss, Malcolm P.** Fluorescent dye penetrant technique for displaying obscure structures in limestone: Jour. Sed. Petrology, v. 38, no. 2, p. 681–682, illus., 1968.

Under ultra violet illumination, fluorescent dye penetrants make conspicuous the minor differences in intergranular porosity and intragranular porosity that are otherwise obscure. Mineral and textural differences that may be revealed may express structures of fabrics, even in certain limestones that do not respond to other techniques.—Authors' abstract

Ali, Syed A. *See* Pincus, Howard J. 03575

03613 **Allard, Gilles O.; Assad, Robert.** Discovery of vanadium in Chibougamau, Quebec [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 569, 1968.

03254 **Allen, J. R. L.; Friend, P. F.** Deposition of the Catskill facies, Appalachian region—With some notes on some other Old Red Sandstone basins, *in* Late Paleozoic and Mesozoic continental sedimentation, northeastern North America—A symposium: Geol. Soc. America Spec. Paper 106, p. 21–74, illus., 1968.

The Middle and Upper Devonian Catskill facies of New York and Pennsylvania interfingers westward with marine rocks. It was derived from a complex source to the east and included low-grade metamorphic with some sedimentary and volcanic rocks. Two subsidiary facies, devoid of marine faunas, show varying proportions of conglomerate, sandstone, and siltstone; textures and structures are indicative of alluvial environments. A third facies occupies a more distal position, contains current-worked marine faunas, and may have formed in a tidal environment. The Catskill is similar to the Old Red Sandstone of Britain and Spitsbergen. Devonian paleogeography developed for the North Atlantic region involves marine-influenced coastal plains symmetrical in relation to a unified

Caledonide fold-belt in which are intermontane basins unconnected with the sea.—*from* Authors' abstract

03535 **Allen, J. R. L.** The diffusion of grains in the lee of ripples, dunes, and sand deltas: Jour. Sed. Petrology, v. 38, no. 2, p. 621-633, illus., tables, 1968.

Deposits formed in the lee of ripples, dunes, and deltas are essentially a case of diffusion developing in a turbulent re-attaching half-jet of low speed with normal gravity. A brief physical exploration is made of behavior of grains under these conditions. Given knowledge of sediment discharge and local properties of sediment load, the rate of settling of grains downstream from the sand-body crest is regarded as a function of the time-average and fluctuating properties of the flow. The central tendency of grain distribution depends on mean properties of motion. The distribution is likely to be skewed toward the larger values of downstream distance and the point of maximum deposition rate lies close to the crest of the sand body. The distribution can be represented by a formula given here.—*from* Author's abstract

03645 **Andersen, Neil R.; Hume, David N.** Determination of barium and strontium in sea water [with French and German abs.]: Anal. Chim. Acta, v. 40, no. 2, p. 207-220, illus., tables, 1968.

A process based on ion-exchange concentration and separation followed by flame photometry has been developed for the determination of strontium and barium at natural levels in sea water. These elements are stripped from I-leader samples of sea water by means of a cation-exchange resin in the calcium form and selectively eluted with CyDTA and EDTA respectively. Factors influencing the intensity of strontium and barium in hydrogen flames have been studied. The standard deviations of the method are 0.05 ppm for strontium and 0.6 ppb for barium and the accuracy of the method is more than sufficient to demonstrate clearly the variability of Sr/Cl and Ba/Cl ratios with depth and location.—Authors' summary

03680 **Andersen, Neil R.; Hume, David N.** The strontium and barium content of sea water, [Chap.] 18 *in* Trace inorganics in water—Am. Chem. Soc., 153d Ann. Mtg., Miami Beach, Fla., 1967, Div. Water, Air and Waste Chemistry Symposium: Washington, D.C., Am. Chem. Soc. (Adv. Chemistry Ser. 73), p. 296-307, tables, 1968.

Concentrations of strontium and barium in [Atlantic Ocean] sea water were simultaneously determined by a combination of ion exchange concentration and flame photometry to ascertain more precisely strontium/chlorinity and barium/chlorinity ratios and to investigate the magnitude and nature of the strontium/chlorinity ratio variation found. The results of analyses from several ocean stations indicate a small (ca. 3 percent) but statistically significant variation in the strontium/chlorinity ratio with respect to depth. A possible variation in the absolute amounts of strontium with geographic location has also been observed. The barium/chlorinity ratio with respect to depth was found to be much larger (ca. 90 percent) than that of strontium.—*from* Authors' abstract

03833 **Anderson, Don L.; Kanamori, Hiroo.** Shock-wave equations of state for rocks and minerals: Jour. Geophys. Research, v. 73, no. 20, p. 6477-6502, illus., tables, 1968.

A method is proposed for estimating the zero-pressure parameters of the high pressure, high-temperature phases formed by intense shock loading of rocks and minerals. Equations of state are fitted to shock-wave data for 18 rocks and minerals. The polymorphic transitions, when they occur, involve a considerable reduction in volume—33 to 49 percent for feldspar- and quartz-rich rocks, 20 percent for mafic rocks, and 12 percent for dense minerals such as spinel, hematite, and magnetite. The parameter $(dK/dP)_s$, related to the Grüneisen ratio, is found to decrease across phase changes and upon iron substitution.—ABV

Anderson, K. H. *See* Wells, J. S. 03774

03614 **Anderson, P. A. M.; Burley, B. J.** The system $NaAlSiO_4$–NaOH–H_2O [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 569, 1968.

03511 **Anderson, Sidney B.; Eastwood, William P.** Natural gas in North Dakota, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1304–1326, illus., tables, 1968.

Almost all natural gas produced in North Dakota is casinghead gas from oil pools in the Madison Group along the Nesson anticline and from pools in Burke County. Relatively minor quantities of dry gas are produced from the gas fields of the North Dakota part of the Cedar Creek anticline. There is a large volume of nitrogen gas in the Minnelusa Formation in the central part of the Nesson anticline, and nitrogen is produced with a heavy crude from the Heath Formation pools in the southwestern part of the state. There are underground storage facilities in the Montana part of the Cedar Creek gas field and storage caverns in salt beds near Williston and Lignite, North Dakota. Gas production in North Dakota is less than demand and gas must be imported.—*from* Authors' abstract

03692 **Anderson, T. W.** Electrical analog analysis of ground-water depletion in central Arizona: U.S. Geol. Survey Water-Supply Paper 1860, 21 p., illus., 1968.

The extensive use of ground water in the Salt River valley and lower Santa Cruz River basin (largest agricultural areas in Arizona) for irrigation has resulted in water-level declines as much as 20 feet per yr in some places. The use of electric-analog modeling techniques has made it possible to predict future ground-water levels under conditions of continued withdrawal in excess of rate of replenishment. Prediction of future water-table conditions is accomplished by extension of pumping trends to determine resultant effect on regional water levels. Results indicate probable depths to water in central Arizona in 1974 and 1984 if aquifer characteristics are accurately modeled and if withdrawal of ground water continues at the same rate and under same areal distribution as existed between 1958 and 1964.—*from* Author's abstract

03631 **Anderson, Wayne I.; Ozias, Karen.** Intraspecific variation within the conodont *Polygnathus brevilamina*: Iowa Acad. Sci. Proc. 1966, v. 73, p. 263–269, illus., 1968.

Intraspecific variation was observed in a study of 177 well preserved specimens of the conodont *Polygnathus brevilamina*. Variations in the size of platform and in the degree of ornamentation of the platform are illustrated. These variations are present in juvenile specimens. The study indicates that the original definition of *Polygnathus brevilamina* is too narrow and that a broader concept of speciation is needed if conodont species are to be useable.—Authors' abstract

03940 **Anderssen, R. S.** Note on conductivity models for the Earth: Jour. Geophys. Research, v. 73, no. 20, p. 6535–6543, tables, 1968.

A method for studying conductivity models for the Earth by integrating the equations of Lahiri and Price by finite difference methods is outlined, and used to examine systematically the Lahiri–Price–Rikitake conductivity model. A number of independent forms for the Lahiri–Price–Rikitake model are obtained; it is shown that an improvement in experimental data is necessary before numerical methods can be applied with success to study of conductivity models and before a reduction in the number of independent forms of this model will be possible. The major problem is one of reducing the degree of non-uniqueness to within manageable limits. The significance of the different forms obtained for the Lahiri–Price–Rikitake model is discussed in relation to previous results. An extended Lahiri–Price–Rikitake model is also introduced in order to study ocean effects. Its use leads to the same conclusions mentioned above.—*from* Author's abstract

03899 **Andrews, J. T.** Pattern and cause of variability of postglacial uplift and rate of uplift in Arctic Canada: Jour. Geology, v. 76, no. 4, p. 404–425, illus., tables, 1968.

Maps of postglacial uplift for Arctic Canada (excluding the Queen Elizabeth Islands) portray a highly irregular surface. Analysis of sites where the elevation and age

of marine limits are known indicates that the variability is explicable in terms of distance from the former ice margin (a measure of ice thickness) and date of deglaciation. These two variables account for 80 percent of the variation in the postglacial uplift at 67 sites, whereas, if postglacial uplift is related solely to distance, only 53 percent of the variation is accounted for. Trend surfaces show postglacial uplift in the last 6,000 years and the present rate of uplift. Models are developed that indicate the effect of different rates of glacial retreat on postglacial uplift, elevation of the marine limit, and strandline deformation.—*from* Author's abstract

Antoine, John. *See* Bryant, William R. 03784

03872 **Armstrong, Richard Lee.** Mantled gneiss domes in the Albion Range, southern Idaho: Geol. Soc. America Bull., v. 79, no. 10, p. 1295–1314, illus., 1968.

The four domes in the Albion Range are cored by a gneiss, schist, quartzite complex, which has an Rb–Sr age of 2.4 b.y., and is unconformably overlain by quartzite, schist, and carbonate rocks, which are sparsely fossiliferous and seem to range from Cambrian to Pennsylvanian in age. Metamorphism, increasing northwestward from greenschist to amphibolite facies, culminated during the Mesozoic. Adamellite, now exposed in the cores of two of the domes, was intruded postkinematically 30 m.y. ago (Oligocene) at an inferred depth of at least 10 km. Unmetamorphosed younger Permian and Triassic(?) sedimentary rocks lie with fault contacts on the metasedimentary rocks. Cenozoic sedimentary and volcanic rocks unconformably overlie the older rocks.—WHN

03815 **Asano, Kiyoshi; Ingle, James C., Jr.; Takayanagi, Yokichi.** Origin and development of *Globigerina quinqueloba* Natland in the North Pacific: Tohoku Univ. Sci. Repts., 2d ser., v. 39, no. 3, p. 213–241, illus., tables, 1968.

This foraminifer inhabits temperate–subarctic ocean waters today. Morphotypes referred to *Globigerina angustiumbilicata* (Bolli) are common in Miocene deposits at western and eastern margins of the North Pacific. Both this species and *G. quinqueloba* (initially recognized in Miocene) are characterized by five chambers in the final whorl and extremely simple morphology. A direct lineage is proposed within the Middle Miocene to Recent interval. Populations were studied from Middle Miocene to Pliocene deposits from Honshu Island [Japan], California, and the Mohole cores. Morphologic measurements show significant variation only in three characters within the lineage: increasing test diameter; shape of final chamber and aperture; and spinosity of the test surface, from smooth to hispid. Subtle ecophenotypic variation hinders clearcut separation of the two species.—*from* Authors' abstract

03619 **Asquith, G. B.** Origin of large kaolinite crystals in the lower Almond Formation in southwest Wyoming: Jour. Sed. Petrology, v. 38, no. 3, p. 948–949, illus., 1968.

Large, elongate (up to 3 mm) subhedral to euhedral crystals of kaolinite were discovered in the Upper Cretaceous Almond Formation near Rock Springs, Wyoming. The kaolinite is present as a 1–3 inch thick underclay in the lower, non-marine portion of the Almond Formation. The large grain size, its well developed crystal form, and the lack of abrasion of the delicate kaolinite books indicate that the kaolinite crystallized in place and is not detrital in origin.—Author's abstract

Assad, Robert. *See* Allard, Gilles O. 03613

Atkinson, Larry P. *See* Menzies, Robert J. 03727

Atwater, Tanya. *See* Menard, H. W. 03924

03669 **Aumento, F.** The space group of prehnite: Canadian Mineralogist, v. 9, pt. 4, p. 485–492, illus., 1968.

The space groups of different constituent domains in prehnite crystals from Farmington, Conn., were identified by single crystal X-ray diffraction, transmission and replication electron microscopy, and electron diffraction. A domain with space

goup P2cm predominant in both X-ray and electron diffraction patterns. Submicroscopic interpenetrational polysynthetic twinning of this domain simulates the space group Pncm. The latter can be observed by X-ray diffraction of apparently single macro-crystals, and by electron diffraction on twinned micro-crystals. A domain with space group P2/n is detectable in minor proportions by X-ray diffraction of macro-crystals, but has yet to be identified by electron diffraction.—Author's abstract

03749 **Axelrod, Daniel I.; Bailey, Harry P.** Cretaceous dinosaur extinction: Evolution, v. 22, no. 3, p. 595–611, illus., tables, 1968.

This report considers the possibility that extinction of dinosaurs may have resulted primarily from stresses produced by decreasing equability, that is, greater extremes of temperature variation, during the later Cretaceous. By later Cretaceous time (Coniacian–Santonian) dinosaurs had been evolving under warm climates of pronounced equability for fully 130 million years, and owing to long continued stabilizing selection presumably were highly adapted to them. During the next 20 million years (post-Santonian), the global temperature gradient increased, together with greater ranges and extremes of temperature; these could have disturbed normal functioning of adaptive responses in dinosaurs, or extended them beyond their normal ranges which were now probably low, and hence lowered chances for their continued survival.—MST

03640 **Backsen, Lee B.; Sendlein, Lyle V. A.** Geology of the proposed Skunk River dam: Iowa Acad. Sci. Proc. 1966, v. 73, p. 190–198, illus., 1968.

The Corps of Engineers plans to construct a dam three miles north of Ames, Iowa, on a reach of the Skunk River which has been displaced approximately two miles to the southeast. The old channel, covered by glacial drift, is not detectable at the surface. Geological investigation provides evidence for the existence of a buried valley. The sands and gravels in this valley are hydraulically connected to the aquifer from which the City of Ames obtains its water supply. Furthermore, the valley underlies a portion of the area of the proposed reservoir. It is quite possible that construction of the dam will have a significant effect on the water supply of the City of Ames, and the buried valley an equally important effect on the proposed reservoir.—*from* Authors' abstract

03667 **Bahat, Dov.** Structural changes at room temperature of heated anorthoclases: Canadian Mineralogist, v. 9, pt. 4, p. 531–538, illus., tables, 1968.

Anorthoclases that had gone through structural changes due to heat treatments showed gradual reverse transformations at room temperature. These reverse transformations are attributed to slight displacements of alkali cations in the strained crystals. The present results seem to support Baskin's suggestion (1956) that the monalbite→analbite transformation takes place from nuclei. The persistency of monalbite nuclei at room temperature appears to be a good measure of the original relative disorder states of the anorthoclases.—Author's abstract

03322 **Bailey, C. A.; Carver, R. D.; Thomas, R. A.; Dupzyk, R. J.** Computer-controlled system for automatically scanning and interpreting photographic spectra [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 353, 1968.

Bailey, Harry P. *See* Axelrod, Daniel I. 03749

03894 **Baker, P. E.** Petrology of Mt. Misery Volcano, St. Kitts, West Indies: Lithos, v. 1, no. 2, p. 124–150, illus., tables, 1968.

Mt. Misery, a recent volcano on the island of St. Kitts in the Lesser Antilles, is built of basalts, basaltic andesites, and andesites of calcalkalic type. Nearly all lavas are strongly porphyritic and zoned calcic plagioclase is the most abundant phenocryst mineral. Coarse-grained ejected blocks are of three types: anorthite-bearing, hornblende-eucrites, and quartz gabbros. Petrographic and mineralogical data are given for representative rock-types and twenty-two new chemical analyses are presented. Brief consideration is given to the various petrogenetic processes applicable to the lavas and comparisons are made with other calcalkaline provinces.

[The most distinctive chemical feature of the Mt. Misery lavas is the persistence of a low K_2O content.]—*from* Author's abstract

03557 **Baker, R. A.** Kurtosis and peakedness: Jour. Sed. Petrology, v. 38, no. 2, p. 679–681, illus., 1968.

Moment kurtosis and graphic "kurtosis" statistics do not necessarily measure either "peakedness" or peakedness relative to the normal distribution. Graphic "kurtosis" statistics may be largely unrelated to moment kurtosis.—Author's abstract

03510 **Bakker, D.** Natural gas in Texas part of Marietta syncline, Cooke and Grayson Counties, Texas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1429–1466, illus., table, 1968.

The area of the Marietta syncline in Cooke and Grayson Counties, Texas, appears to have the greatest potential for future gas production in North Texas. Extensive exploration for gas in this area began in 1951, although it long had been important for oil production. Both oil and gas accumulations are controlled mainly by structure. Solution gas is the main type of gas produced, but production of nonassociated gas is expected to increase. Solution-gas production is mostly from sandstones of Pennsylvanian (Des Moines and Atoka) age. Important gas-distillate reserves have been discovered in the Oil Creek Formation of Ordovician age, and the Ellenburger also yields some gas distillate. The Oil Creek and Ellenberger should receive further exploration. The multiple-pay section in this area is the deepest and thickest in North Texas.—Author's abstract

Baleshta, T. M. *See* Keys, J. D. 03760

03478 **Ball, Douglas; Burnett, Peter Geddes.** Storage of gas in water sands, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1890–1898, illus., table, 1968.

Most of the present underground gas storage in the United States is in old oil and gas fields, but artificial gas fields have been made where suitable conditions are known. Reservoir engineering studies generally are helpful in the evaluation of the suitability of a reservoir rock and cap rock before gas is injected. In the development of a water-sand storage, water is pushed away from the storage area by gas injection at a pressure higher than the existing hydrostatic pressure. Several types of storage areas from many parts of the world are described.—*from* Authors' abstract

Banks, Philip O. *See* Gomberg, David N. 03853

03718 **Banshchikova, I. V.** Vklyucheniya v chkalovite i nefeline massiva Ilimaussak (Grenlandiya) [abs.], *in* Vsesoyuznoye Soveshchaniye po Mineralogicheskoy Termobarometrii i Geokhimii Glubinnykh Mineraloobrazuyushchikh Rastvorov, 3d, 1968, Tezisy Dokladov: Moscow, Vses. Nauch.-Issled. Inst. Sinteza Mineral. Syr'ya, p. 22–24, 1968.

03714 **Barghusen, Herbert R.** The lower jaw of cynodonts (Reptilia, Therapsida) and the evolutionary origin of mammal-like adductor jaw musculature: Postilla, no. 116, 49 p., illus., 1968.

The evolution of feeding apparatus is described from *Dimetrodon*, a pre-therapsid reptile, through the theriodont therapsids, carnivorous mammal-like reptiles. Osteological changes are analyzed in terms of modifications in adductor jaw musculature. Two groups of theriodont therapsids present evidence that each independently departed from the more primitive arrangement of adductor jaw musculature. In cynodonts, two major changes occurred—the appearance of a masseter muscle whose development was closely related to posteroventral expansion of the dentary, and the development of a pattern of insertion characteristic of mammalian temporalis muscles. As a result of these modifications, the cynodonts closely approach the adductor jaw musculature of living mammals, and appear to be excellent candidates for the ancestors of all mammals.—MST

03301 **Barnes, R. M.; Gordon, W. A.** Development of automation and computer analysis for emission spectrochemical analysis using a direct-reading spectrometer [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 366, 1968.

Barnes, Robert H. *See* Wilson, Charles W., Jr. 03582

03704 **Barnes, Robert H.** Geologic map of the Hustburg quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 31-NW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Hustburg quadrangle, Tennessee," by L. T. Larson is cited separately.—MCM

03710 **Barnes, Robert H.; Wilson, Charles W., Jr.** Geologic map of the Gassaway quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 323-NW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Gassaway quadrangle, Tennessee," by C. W. Wilson, Jr. is cited separately.—MCM

03711 **Barnes, Robert H.; Wilson, Charles W., Jr.** Geologic map of the Baxter quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 326-NW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Baxter quadrangle, Tennessee," by L. C. Taylor and C. W. Wilson, Jr. is cited separately.—MCM

03495 **Bartlett, Charles S., Jr.** Washburn anticline gas fields, Arkansas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1658-1667, illus., 1968.

The Gragg, Booneville, and Chismville gas fields are all on the surface expression of the 40-mile-long Washburn anticline. Production, essentially dry methane gas, is from 15 different sand units in the Atoka Formation. The approximately 11,700 ft Atoka Formation can be divided into zones which can be recognized in most wells. Lenticularity of the sandstones and marked variation in porosity and permeability in the gas zones reflect the unstable shallow-basin environment in which the sands were deposited. Strike-thrust faults trending east-west near the crest of the Washburn complicate the structure. Nearly every well has cut one fault with displacement commonly being 1,000 feet or more.—*from* Author's abstract

03539 **Bascomb, C. L.** A new apparatus for recording particle size distribution: Jour. Sed. Petrology, v. 38, no. 3, p. 878-884, illus., tables, 1968.

A manometer and sensitive capacitance transducer follow the drop in hydrostatic pressure at a point near the bottom of a column of soil suspension during sedimentation. Current from the transducer is fed to a recorder which traces an accumulation curve. The first derivative (slope of the curve) gives a summation curve of the particle size distributions. Results on four soils with different particle size distributions agree with those obtained by a standard pipette-sampling/sieving procedure over the range 20-200 microns effective settling diameter.—Author's abstract

03615 **Bayliss, P.** The different crystal structures of gersdorffite (NiAsS) [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 570, 1968.

03335 **Beach, Floyd K.** Geology of natural gas—Saskatchewan Paleozoic, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1285-1287, illus., 1968.

Only one gas well in Saskatchewan produces nonassociated natural gas from strata of the Paleozoic Era. The well is in the Antelope pool, straddling the Saskatchewan-Alberta border, and produces at a rate of 3 million cu ft a day. In addition, approximately 17 million cu ft a day of dissolved gas is gathered in the production of oil from the Mississippian in southeast Saskatchewan.—Author's abstract

03549 **Beall, Arthur O., Jr.** Sedimentary processes operative along the western Louisiana shoreline: Jour. Sed. Petrology, v. 38, no. 3, p. 869–877, illus., 1968.

The southwestern Louisiana shoreline demonstrates a complex interaction of "sediment supply" and "energy of coastal processes" (Bernard, 1965). Shallow water "wave energy" and proximity to suspended mud supply are qualitatively shown to be dominant variables. Facies tracts show variation through a broad spectrum of geometrics and sediment types. Mudflats, both intertidal and subaqueous, show highest rates of progradation, as compared to "normal" sand-rich beaches with low rates of progradation. An "intermediate" type of strandline, represented by a thin sand beach resting on eroded mudflat and marsh sediment, is shown to prograde at rates intermediate between those of mudflats and "normal" beaches. Consideration of interaction of various partially dependent sedimentary processes can be used to characterize rates of progradation as well as to predict sediment type and geometry.—*from* Author's abstract

03804 **Becker, V.; Bennett, J. H.; Manuel, O. K.** Iodine and uranium in ultrabasic rocks and carbonatites: Earth and Planetary Sci. Letters, v. 4, no. 5, p. 357–362, tables, 1968.

A series of ultrabasic rocks and carbonatites were analyzed by neutron activation for iodine and uranium. The uranium data are compared with earlier data on the uranium content of possible mantle material. The high uranium content of the carbonatites, 0.80–8.0 ppm, indicates that these may make a sizeable contribution to the average terrestrial heat flow. The iodine and uranium data are compared with the iodine and uranium contents of stone meteorites and with the xenon decay products of extinct I–129 and Pu–244 in the meteorites. The concentrations of these decay products in the atmosphere are used to show that the earth began to retain these gaseous products as early as the eucrite chondrite.—Authors' abstract

03326 **Beebe, B. W.; Hanley, John M.** Natural gas resources of the United States, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 2185–2217, illus., tables, 1968.

Total future potential supply of gas consists of estimated proved recoverable reserves and undiscovered future supplies. The latter in order of increasing uncertainty consist of: development of known deposits—lateral or vertical extensions and revisions of estimates; new discoveries in geological provinces and formations and types of traps already proved productive; in geologic provinces known to be productive but in remote areas, in new types of accumulation, and/or in formations not known previously to be productive in that area; and, the most speculative, in provinces which have not yet produced gas. Estimation of undiscovered reserves is a geologic and engineering problem. Most estimates extant have been based on questionable methods and have used obsolete and conflicting data. Two factors are important: thorough knowledge of the relation of gas to geology of the area, and experience.—*from* Authors' abstract

03477 **Beebe, B. W.; Curtis, Bruce F.** Natural gases of North America—A summary, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 2245–2355, illus., tables, 1968.

A survey of all of the aspects of the natural gas industry is given. Included are discussions of history, the industry in the United States and the rest of North America in 1965, mineral economics, interfuel competition, reserves, life of fields, chemistry and physics of natural gas, nonhydrocarbon gases, geologic distribution, giant fields, origin of gas accumulations, composition of petroleum gases, gas occurrence in rocks, migration of gas, entrapment, general geology of natural gas, economic considerations, and legal aspects.—HRC

Beebe, B. W. *See* Knight, G. L. 03484

03332 **Beebe, B. Warren; Curtis, Bruce F.** (editors). Natural gases of North America, a symposium in two volumes—V. 2: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1227–2493, illus., tables, 1968.

This volume is in two parts, as is volume 1. Part 3 contains descriptions of natural gas fields in Paleozoic rocks, and part 4 contains papers of a general scope. Each is cited separately by author.—HRC

Bell, A. H. *See* Bond, D. C. 03491

03691 **Bell, Edwin A.; Nyman, Dale J.** Flow pattern and related chemical quality of ground water in the "500-foot" sand in the Memphis area, Tennessee: U.S. Geol. Survey Water-Supply Paper 1853, 27 p., illus., tables, 1968.

The "500-ft" sand is the major source of water for the Memphis area; thick layers of impervious clay above and below confine the water in the aquifer under artesian pressure and also protect it from contamination. Recharge is from rainfall and other aquifers; discharge results from well pumping. Continuous withdrawals since 1886 have lowered water levels and altered hydraulic gradients, resulting in changes in direction and velocity of movement of water through the sand. Water is generally a calcium magnesium sodium bicarbonate type, soft, low in dissolved solids, high in iron and carbon dioxide concentrations, and somewhat corrosive. Variations in chemical quality enroute through the sand are virtually proportional to increases or decreases of the major chemical constituents. Some changes in chemical quality can be anticipated with development of the area.—*from* Authors' abstract

Bell, S. Allen. *See* Kolpack, Ronald L. 03568

03644 **Belousov, V. V.; Kosminskaya, I. P.** Structure and development of transition zones between the continents and oceans, *in* Symposium on continental margins and island arcs, 3d, Zurich, 1967: Canadian Jour. Earth Sci., v. 5, no. 4, pt. 2, p. 1011-1026, illus., 1968.

The *Atlantic* type of continent-oceanic margin is characterized on the continental side by the platform regime; the development of the marginal zones was here accompanied by subsidence of the marginal part of the pre-Mesozoic foundation with an increase of tilt toward the ocean. The margins of the *Pacific* type are characterized by a regime which developed on the largely differing geosynclinal structures of continents. Sinking of large blocks is followed by disintegration into smaller blocks and by volcanism forming island arcs. These mechanics are only one cause of the different types of margins. The restoration processes, derived from the response of the mantle, are different also, the *Atlantic* type being more regular and the *Pacific* type being more diverse and complicated.—*from* Authors' abstract

03252 **Belt, Edward S.** Carboniferous continental sedimentation, Atlantic Provinces, Canada, *in* Late Paleozoic and Mesozoic continental sedimentation, northeastern North America—A symposium: Geol. Soc. America Spec. Paper 106, p. 127-176, illus., tables, 1968.

The Carboniferous continental strata of eastern Canada are classified into fanglomerate, fluvial, lacustrine, and mixed fluvial and lacustrine facies. Each facies contains formations that are widely distributed geographically and vertically; each is related genetically to a rift valley framework, basement mobility, and climate. The data reported to indicate depositional environment consist of distribution of lithology, fossils, and primary structures within each facies. The fanglomerate grades laterally into the fluvial facies and contains crudely stratified clasts from basement rocks; the fluvial facies, sandstone interbedded with lutite, suggests channel deposits; the lacustrine facies, typically calcareous lutite variably laminated, indicates depth fluctuations; the intertonguing fine fluvial and lacustrine deposits indicate a flat central-basin region of fluctuating lakes.—GDC

03898 **Bence, A. E.; Albee, A. L.** Empirical correction factors for the electron microanalysis of silicates and oxides: Jour. Geology, v. 76, no. 4, p. 382-403, illus., tables, 1968.

Analysis of minerals by the electron microprobe is facilitated by the use of pure oxides and binary oxide phases as standards. Correction factors (a) are determined, based on Ziebold-Ogilvie equation: $C_A/K_A = a_{AB}+(1-a_{AB})C_A$, where C_A is the concentration of element A in solid solution AB, K_A is the background-corrected

intensity of a characteristic radiation of A in Ab, and a_{AB} is an instrumentally determined parameter or correction factor. Extension of this method to multicomponent systems is described. Correction factors for Na, Mg, Al, Si, K, Ca, Ti, Cr, Mn, and Fe are given, using synthetic and mineral standards.—*from* Authors' abstract

Bennett, J. H. *See* Becker, V. 03804

03722 **Bennett, J. M.; Smith, J. V.** Positions of cations and molecules in zeolites with the faujasite-type framework—[Pt.] 1, Dehydrated Ca-exchanged faujasite: Materials Research Bull., v. 3, no. 8, p. 633–642, illus., tables, 1968.

Ca-exchanged faujasite dehydrated under vacuum at 475°C and measured at room temperature has 14 Ca in S(I) , 3 in S(I') and 11 in S(II). This distribution and the interatomic distances agree with energy minimization for a simple electrostatic model—Authors' abstract

Bennin, Robert S. *See* Sanders, John E. 03537

Bergenback, R. E. *See* Williams, E. G. 03577

Berger, Rainer. *See* Taylor, R. E. 03719

Bernard, Claude. *See* Laverdière, Camille. 03738

03293 **Bernstein, Frank.** Experience with a computer-coupled X-ray spectrometer [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 362, 1968.

03868 **Beus, Stanley S.** Paleozoic stratigraphy of Samaria Mountain, Idaho-Utah: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 782–808, illus., table, 1968.

Exposed strata of Ordovician through Early Permian age in the Samaria Mountain area comprise the following formations: Swan Peak quartzite, Fish Haven Laketown Dolomite sequence, Water Canyon Formation, Jefferson Formation, Humbug Formation, Great Blue Limestone, Manning Canyon Formation, Oquirrh Formation and Phosphoria Formation. The Jefferson Formation is divided into two members: the Samaria Limestone Member (new) and the Hyrum Member. The Lodgepole Limestone has four informal members. Three members are recognized in the Oquirrh Formation: The West Canyon Limestone Member (Morrowan-Atokan), the middle member (Late Pennsylvanian)y and the upper member (Early Permian). A major unconformity occurs between the West Canyon and upper members. The middle member is apparently an allochthonous complexly folded and thrust-faulted mass which overlies the upper member.—WCC

03664 **Bickel, David.** Correction for Pleistocene checklist of Recent and Pleistocene Mollusca of Kentucky: Sterkiana, no. 31, p. 14, 1968.

Helicodiscus barri Hubricht, 1962, and *Helicodiscus inermis* Baker, 1929 were incorrectly listed (Sterkiana, no. 28, p. 15, 1967) as being recorded from Kentucky in Hubricht (1964). This species was reported only from Tennessee.—HRC

03657 **Bird, John M.; Rasetti, Franco.** Lower, Middle, and Upper Cambrian faunas in the Taconic sequence of eastern New York—Stratigraphic and biostratigraphic significance.: Geol. Soc. America Spec. Paper 113, 66 p., illus., table, 1968.

Three Lower, two Middle, and two Upper Cambrian trilobite faunas from the Taconic sequence in the region of Columbia County, New York, contain diagnostic genera and species in unquestionable stratigraphic order, allowing precise correlation with Cambrian strata of other regions of North America and Europe. The trilobites occur in lenticular limestones which are interstratified with a greater thickness of grey, green, or black unfossiliferous shales. These findings indicate no unconformity exists between Lower Cambrian and Lower Ordovician strata of the Taconic sequence in the southern portion of the Taconic allochthon, and that an essentially complete sedimentary sequence probably extends from the Cambrian system upward into the Lower Ordovician.—MST

Bishop, Charles C. *See* Chapman, Rodger H. 03723

Bishop, Charles C. *See* Chapman, Rodger H. 03724

03683 **Bjork, Philip R.** New records of helaletid tapiroids from the Oligocene of South Dakota: Michigan Acad. Sci., Arts and Letters Papers 1967, v. 53, p. 73–78, illus., table, 1968.

Three specimens of the relatively rare tapiroid *Colodon* are described from the White River Group of the Big Badlands of South Dakota. These jaw fragments are smaller than any of the 40-odd specimens from that region studied by Radinsky (1963). The two from the Chadron Formation can be assigned to *C. kayi* on the basis of small size of teeth compared with Radinsky's specimens of *C. kayi* and *C. occidentalis*. That from the overlying lower Brule Formation seems intermediate in size between the species; it is too incomplete to be compared directly with *C. kayi*. Discovery of *C. kayi* in the Chadron marks survival of an ancestral form alongside its descendent, *C. occidentalis*. Ecologic relationship of these species and *C(?) cingulatus* in the Eocene–Oligocene Plains and Mountains faunal provinces is conjectured.—VMJ

03258 **Blackburn, W. H.; Pelletier, Y. J. A.; Dennen, W. H.** Spectrochemical determinations in garnets using a laser microprobe: Appl. Spectroscopy, v. 22, no. 4, p. 278–283, illus., tables, 1968.

Spectrochemical determinations of Fe, Mg, Mn, and Ca in garnets by use of a laser microprobe were performed in matrix. Standards were prepared by fusion of chemically analyzed mineral powders and these standard glasses were excited in the same manner as the mineral unknowns. Comparison of results with the rock standard W-1 showed good accuracy and reproducibility. The precision and accuracy of the method as a whole deems it suitable for most mineralogic investigations where analysis in matrix is desirable.—Authors' abstract

Blackwelder, Blake W. *See* Pilkey, Orrin H. 03541

03508 **Blanchard, K. S.; Denman, Orval; Knight, A. S.** Natural gas in Atokan (Bend) section of northern Fort Worth basin, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1446–1454, illus., 1968.

Sandstone and conglomerate lenses, locally known as "Bend Conglomerates," of Early Pennsylvanian age in Jack, Parker, and Wise Counties, Texas, are characterized by extreme variability in lateral extent. Conglomerate bodies present in one well commonly are not present in the offset well. Some wells contain as many as eight separate lenses with a combined pay thickness of more than 100 ft. The Boonsville (Bend Conglomerate) gas field and the Toto (lower Bend Conglomerate) gas field cover an area of approximately 450 sq mi in Jack, Parker, and Wise Counties and contain more than 875 gas wells producing from the Bend Conglomerate lenses. Monthly gas production from these wells is 5.75 million cu ft, and estimated recoverable reserve is more than 1 trillion cu ft.—*from* Authors' abstract

03803 **Blankennagel, Richard K.** Geophysical logging and hydraulic testing, Pahute Mesa, Nevada Test Site: Ground Water, v. 6, no. 4, p. 24–31, illus., 1968.

Geophysical logs and special hydraulic tests were used by the U.S. Geological Survey to evaluate hydrologic properties of the volcanic terrane at Pahute Mesa. The mesa overlies a deep structural basin of more than 13,600 feet of rhyolitic tuff and lava flows, faulted with vertical displacement ranging from a few to 600 feet; most test holes were between 4,500 and 8,000 feet deep. With little information available for interpreting drill-hole logs in rhyolitic volcanic rocks, experience on Pahute Mesa shows how qualitative data on rock lithologies and hydraulic conditions may be obtained by electric, caliper, temperature, and fluid resistivity logs. Quantitative data on the major water-yielding intervals are obtained from radioactive tracer or spinner surveys, verified by isolating specific zones with inflatable packers and spacers, to be tested by fluid injection or swabbing.—GDC

03814 **Bodmer, René; Ward, S. H.; Morrison, H. F.** On induced electrical polarization and groundwater: Geophysics, v. 33, no. 5, p. 805–821, illus., 1968.

Clay horizons and other clay-bearing unconsolidated sediments are potential sources of induced-polarization anomalies. If such anomalies may be detected above system noise, the induced-polarization method may be of value for in-situ classification of unconsolidated sediments encountered in hydrological projects. One such project exists in Santa Clara County where near-surface unconsolidated sediments are frequently considered as potential recharge areas. Of four areas surveyed with induced-polarization apparatus in Santa Clara County, only two yielded significant frequency-effect anomalies, and in each of these two the frequency effects were of the order of three percent. These anomalous frequency effects may be related to clayey gravels. The dipole-dipole array, with spreads of 10 ft and 20 ft, was typically used in the study.—Authors' abstract

Boerma, J. A. K. *See* Bouma, A. H. 03808

03263 **Boettcher, A. L.; Wyllie, P. J.** The calcite-aragonite transition measured in the system CaO–CO_2–H_2O: Jour. Geology, v. 76, no. 3, p. 314–330, illus., table, 1968.

Study of melting relations in the system CaO–CO_2–H_2O included redetermination of the calcite-aragonite transition. The problem of loss of aragonite during quenching was solved by observing the morphology of carbonate crystals and by using the fact that aragonite grains in equilibrium with the ternary liquid differ in shape from those of calcite. The triple point for aragonite+calcite I+calcite II is at 480°C and 9.4 kb. The lowest point measured on the aragonite-calcite I curve is 400°C and 8.3 kb, and the highest point measured on the aragonite-calcite II curve is 800°C and 19.8 kb.—*from* Authors' abstract

03937 **Boettcher, A. L.; Wyllie, P. J.** Jadeite stability measured in the presence of silicate liquids in the system $NaAlSiO_4$–SiO_2–H_2O: Geochim. et Cosmochim. Acta, v. 32, no. 9, p. 999–1012, illus., table, 1968.

The reactions nepheline+high albite⇌jadeite and high albite⇌jadeite+quartz were measured in the presence of high-pressure vapors and silicate melts in the system $NaAlSiO_4$–SiO_2–H_2O for the temperature range 600–800°C. Kinetics were such that complete reaction was attained in most runs. The results of these determinations together with previous studies in this sytem and recent thermochemical data collectively place narrow restrictions on the positions of the above reactions over a wide temperature range. An entropy change of 3.5 eu accompanying the transformation of low to high albite is in good agreement with those results. Some data are also provided for the reaction analcite+high albite⇌jadeite+vapor. It is concluded that jadeite can form in a variety of geologic environments at pressures lower than previously determined.—Authors' abstract

Boettner, E. A. *See* Grunder, F. I. 03280

03653 **Boggess, Durward H.; Heidel, Sumner G.** Water resources of the Salisbury area, Maryland: Maryland Geol. Survey Rept. Inv. 3, 69 p., illus., tables, 1968.

Large quantities of good-quality water are available in the upper Wicomico River basin; the Salisbury Formation of Pleistocene age, supplying most of the 8 mgd used in the area, has an estimated potential of 45 mgd (about equal to surface water supply). Large untapped reserves of ground water are available from channel-fill deposits in the Naylor Mill paleochannel where the Salisbury Formation attains a maximum thickness of 230 feet; individual wells might yield 3,000–4,000 gpm in the thicker parts. Smaller quantities of water, generally of poorer chemical quality, are available from underlying artesian aquifers; the major alternate sources, the Manokin and Nanticoke aquifers of Miocene age, are used only in areas where overlying Pleistocene sediments are thin, or contain water of undesirable quality. Basic data from well logs is tabulated, and geologic units are correlated.—GDC

03292 **Boltz, David F.** Indirect atomic absorption spectrometric methods of analysis [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 361, 1968.

03491 **Bond, D. C.; Bell, A. H.; Meents, W. F.** Gas in Illinois basin, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1746–1753, illus., tables, 1968.

Most of the gas in the Illinois basin has been solution gas produced from oil wells. Gas also comes from gas caps over oil reservoirs and from nonassociated gas fields. Only one field, Midland, in Kentucky, contained more than 100 billion cu ft. All of the oil and gas is in or near Upper Mississippian rocks and most of the remainder is from Pennsylvanian rocks. Both structural and stratigraphic traps are numerous. Erratically-distributed porous and permeable traps near the tops of anticlines are also common. Tables show gas field data and underground storage projects.—HRC

03808 **Bouma, A. H.; Boerma, J. A. K.** Vertical disturbance in piston cores: Marine Geology, v. 6, no. 3, p. 231–241, illus., 1968.

Piston cores collected from the Atlantic Ocean and from the shelf of Surinam appeared to have vertical disturbances in their lower part in about 40 percent of all cases. The phenomenon could be detected in most cases after the core had been split lengthwise and when the sediment was dried out sufficiently so that small textural differences stood out. Fresh cores were examined by means of X-ray radiography. The change from normal "horizontal" sedimentary structures into vertical line patterns is also sudden. It is most likely that these disturbances originate by the upward motion of the piston during the first stage of pulling up of the coring device, which leads to sucking up of sediment. (When dealing with hard sediments, the penetration may be little and the corer may fall over, thus pulling up the piston.)—Authors' summary

Bowen, Vaughan T. *See* Högdahl, Ove T. 03681

03876 **Boyd, Donald W.; Newell, Norman D.** Hinge grades in the evolution of crassatellacean bivalves as revealed by Permian genera: Am. Mus. Novitates, no. 2328, 52 p., illus., tables, 1968.

The discovery of well-preserved examples of Crassatellacea of Permian age in Wyoming clarifies some problems of the early history of the group. By the acquisition of additional hinge teeth after Permian time, the hinge of living crassatellaceans became modified in separate lines from basically lucinoid to a more advanced hinge grade. The Bernard and Munier-Chalmas hinge formula and its implication of dental homologies are discussed, and a simplified, more objective hinge notation based on the Steinmann system is employed. Two new species, *Oriocrassatella elongata* and *Astartella aueri*, are described.—KAF

03811 **Brace, W. F.; Martin, R. J., 3d.** A test of the law of effective stress for crystalline rocks of low porosity: Internat. Jour. Rock Mechanics and Mining Sci., v. 5, no. 5, p. 415–426, illus., tables, 1968.

A variety of crystalline silicate rocks of low porosity were fractured in triaxial experiments at strain rates from about 10^{-3} to 10^{-8} sec^{-1}. Comparison of fracture strengths at different pore pressures provided a test of the law of effective stress for these rocks. Tests revealed that the law held only when loading rate was less than some critical value which depended on permeability of the rock, viscosity of the pore fluid, and sample geometry. In experiments with water, it was about 10^{-7} sec^{-1} for cylindrical samples of granite several centimeters long; at loading rates greater than the critical value, the rock was as much as 50 percent stronger than at zero pore pressure. This effect could be significant for rock stressed by earthquake motion or in the vicinity of buried nuclear explosions.—*from* Authors' abstract

03497 **Branan, C. B., Jr.** Natural gas in Arkoma basin of Oklahoma and Arkansas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1616–1635, illus., table, 1968.

The sedimentary column is estimated to be 30,000 feet, and the rocks have been highly deformed. Block faulting, perhaps contemporaneous with sedimentation, has been recognized during the Pennsylvanian. Early Permian folding and overthrusting are the major sources of structures. Most of the gas in the basin is from lenticular,

fine-grained sandstone within the Pennsylvanian Atoka sequence. Individual sandstone lenses are difficult to correlate because they are lenticular, but the basal Spiro sand is an exception, and is the major source of gas. The province is essentially dry-gas, with about 95 percent methane. To date, there are 25 gas-producing zones ranging in age from Ordovician to Pennsylvanian. The Red Oak field, Oklahoma is the largest single producer. Most of the traps in the basin are stratigraphic.—HRC

03331 **Braunstein, Jules; O'Brien, G. D.** (compilers). Indexed bibliography of diapirism and diapirs, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 358–414, 1968.

This bibliography is a common references-cited section for the papers in this symposium on diapirs and diapirism, and also contains many other references which are pertinent. There are approximately 1,800 entries, indexed to eight different main topics.—HRC

03468 **Braunstein, Jules; O'Brien, Gerald D.** (editors). Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, 444 p., illus., 1968.

This symposium contains twenty-two articles, ten of which deal with the general topic of diapirism and the remainder with specific examples, many from North America. An indexed, common bibliography occurs at the end. Each paper is cited separately. Some of these articles were included in the 50th annual meeting of the American Association of Petroleum Geologists at New Orleans, 1965.—HRC

03279 **Brech, Frederick.** Atomic absorption, flame emission, and atomic fluorescence spectroscopy—A comparison and a review [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 359, 1968.

Brewer, Helene B. *See* Whitney, Marion Isabelle. 03674

Brey, Mary E. *See* Fabricand, Burton P. 03554

Brietkrietz, Alex. *See* Konizesk, R. L. 03625

Brosgé, W. P. *See* Gryc, George. 03799

Broussard, W. L. *See* Harder, A. H. 03766

Brown, Boyd R. *See* Picard, M. Dane. 03512

Bryant, Donald L. *See* Rea, David K. 03890

03784 **Bryant, William R.; Antoine, John; Ewing, Maurice; Jones, Bill.** Structure of Mexican continental shelf and slope, Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 7, p. 1204–1228, illus., 1968.

Structurally the Mexican shelf and slope are composed of a series of anticlines that start from the continental rise and continue under the continental shelf. The general trend of these features is in the direction of the shelf break. The structural features observed on the eastern Mexican shelf and slope are postulated to have originated by the possible mechanism of (1) compressional folding, resulting from gravity sliding along a decollement surface or other tectonic stresses; or (2) vertical movement of shale or salt masses related to static loading.—*from* Authors' abstract

03794 **Buckley, James D.; Trautman, Milton A.; Willis, Eric H.** ISOTOPES' radiocarbon measurements VI: Radiocarbon, v. 10, no. 2, p. 246–294, 1968.

This list presents dates on a portion of the samples measured at ISOTOPES since publication of ISOTOPES V (ibid., v. 8, p. 161–203, 1966), and for previously analyzed samples for which complete sample data are now available. Geologic samples are from western United States (including Alaska), central and eastern United States, Canada, Europe, Africa, Australia, Mexico, and Bermuda. Physical geography samples are from Northwest Territories and Great Britain, and

archeologic samples are from United States, Canada, Europe, Iran and Peru. MCM

Bufe, Charles G. *See* Schimke, Gerald R. 03928

Buffington, Edwin C. *See* Moore, David G. 03793

03750 **Burand, W. M.** Geochemical investigations of selected areas in the Yukon Tanana region, Alaska, 1965 and 1966: Alaska Div. Mines and Minerals Geochem. Rept. 13, 51 p., illus., tables, 1968.

Data obtained by geochemical investigations of 475 samples of stream sediments from four selected areas are presented. Cold extractable heavy metals were tested in the field, and a part of each sample sent away for analyses of copper, zinc, lead, and molybdenum; 68 were analyzed for nickel. Results are recorded in tables, and frequency distribution graphs are plotted for each metal by district. Threshold values for anomalous quantities were determined and anomalous samples are indicated on a map. Only one sample in the upper Tolovana River basin was anomalous, indicating that mineralization to the west does not extend into this area. Anomalous samples outline three areas of mineralization in the Mastodon Dome–Porcupine Dome area, near the placer gold deposits. Four areas in the Columbia Creek–O'Brien Creek area and four in the Pedro Dome–Coffee Dome area are worthy of further study.—ESL

Burley, B. J. *See* Anderson, P. A. M. 03614

03686 **Burnett, John L.** Geology of the Lake Tahoe Basin, *in* Geologic studies in the Lake Tahoe area—Geol. Soc. Sacramento, Ann. Field Trip Guidebook, 1968: Sacramento, Calif., Geol. Soc. Sacramento, p. 1–13, illus., table, 1968.

Lake Tahoe Basin is a product of faulting of Basin and Range type although the rocks are predominantly those of the Sierra Nevada Province. Volcanic andesite forms the dam creating the lake in the basin. While remnants of pre–Cretaceous metamorphic rocks are found scattered about as roof pendants, granitic intrusive rocks of the Nevadan batholith complex are the dominant rocks. Granodiorite is the most abundant rock, with quartz diorite, diorite, and gabbro being present in lesser amounts. Cenozoic lavas present are correlated with the Kate Peak Formation to the northwest; the vents are unknown. Glacial deposits of Pleistocene age overlie most of the area; and Quaternary alluvium and erosion are evident also.—HRC

Burnett, Peter Geddes. *See* Ball, Douglas. 03478

Burnham, C. Wayne. *See* Holloway, John R. 03831

03295 **Burr, Alex. F.** Shift in wavelength with voltage of certain X-ray lines [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 363, 1968.

03530 **Busch, F. E.; Hudson, J. D.** Ground-water levels in New Mexico, 1966—Basic data report: Santa Fe, N. Mex., New Mexico State Engineer, 71 p., illus., tables, 1968.

This report tabulates annual measurements of water levels in a network of about 1,490 observation wells in New Mexico. The areas of ground-water observation are in seven major surface-water-drainage basins or groups of basins. Reported measurements were made during January or February 1967, and when compared with those made in the same months of 1966 reflect water-level changes during 1966.—*from* Authors' abstract

03244 **Buttner, Peter J. R.** Proximal continental rhythmic sequences in the Genesee Group (lower Upper Devonian) of southeastern New York, *in* Late Paleozoic and Mesozoic continental sedimentation, northeastern North America—A symposium: Geol. Soc. America Spec. Paper 106, p. 109–126, illus., 1968.

Rhythmic continental sequences characterize the proximal Genesee Group (Upper Devonian) in southeastern New York, which are interpreted as the remnant elements of a sequence of coastal-plain and upland fluvial deposits. A rhythm consists of a braided pattern of coarse conglomeratic channel-fill, a composite of point-bar, channel-fill, and overbank sandstones, and overbank, mudflat, and general flood-plain accumulations of siltstones and mudrocks. Widespread lateral variability, rapid vertical change, channel depths of more than 30 feet, and textural mapping suggest a significant fall-line scarp close to the east of the present outcrop limit. Various aspects of the natural rhythmic sequences of the Genesee Group have been synthesized and examined using [computer] simulation techniques.—Author's abstract

Cabri, L. J. *See* Keys, J. D. 03760

03763 **Cabri, L. J.; Rucklidge, J. C.** Gold-silver tellurides—Relation between composition and X-ray diffraction data: Canadian Mineralogist, v. 9, pt. 4, p. 547–551, illus., tables, 1968.

Electron-probe microanalyses of natural krennerites and sylvanites, containing no minor elements, have supported previous estimates of silver content using a d-value curve obtained from synthetic samples. The correspondence for the silver content of natural calaverite is not well established. Examples of krennerite and calaverite containing minor elements have been found. Krennerite can incorporate minor Cu in its structure which permits the mineral to have a lower percentage silver than normal krennerite. Calaverite has been found to contain both Cu and Sb in minor amounts permitting the structure to exist with more silver than in the Au-Ag-Te system.—Authors' abstract

03870 **Calvert, Mont G., Jr.** Claud Victor Winter, Jr. (1925–1968): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 868, portrait, 1968.

03849 **Cameron, Francis.** What is a "have not" nation?: Mining Eng., v. 20, no. 4, p. 59–64, illus., tables, 1968.

Gloomy predictions that domestic mineral reserves are approaching exhaustion are unwarranted and may be harmful. Predictions for consumption and production of copper, lead, and zinc made in the 1952 Paley report generally do not compare favorably with actual data because of various unpredictable causes. Given a reasonable economic climate the United States is not only not a "have not" nation with respect to most of our metals but is actually more fortunate than most modern nations in terms of self sufficiency. "Have not" nations are those which relegate their basic industries to a role of insignificance in their economices. Five suggestions are given to assure that the U.S. never becomes such a nation.—MAC

Campbell, Carlyle B. *See* Davis, Richard Arnold. 03633

03306 **Campbell, Clement; Taylor, Francis R.** Emission spectra of magnesium-chlorine trichloride [trifluoride!] flames [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 367, 1968.

Campbell, E. Y. *See* Gottfried, David. 03935

03791 **Campbell, R. L., Jr.** Stratigraphic applications of dipmeter data in Mid-Continent: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1700–1719, illus., 1968.

To detect crossbedding and describe its orientation within thin sedimentary units with dipmeter techniques, independent correlation intervals must yield computed dips for every few feet of hole. Many of the dips computed were caused by current bedding, and they indicate the direction of sediment transport. To emphasize trends and minimize random events, statistical methods are used. Azimuth-frequency diagrams and modified Schmidt plots show the direction of sediment transport, the direction of interval thickening, and present structural dip.—*from* Author's abstract

03336 **Canada Geological Survey.** Aeromagnetic series, Tikerarsuk Point, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4727, scale 1:63,360, 1968.

03337 **Canada Geological Survey.** Aeromagnetic series, Eqe Bay, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4728, scale 1:63,360, 1968.

03338 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 H/4, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4738, scale 1:63,360, 1968.

03339 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 E/13, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4739, scale 1:63,360, 1968.

03340 **Canada Geological Survey.** Aeromagnetic series, Rimrock Lake, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4740, scale 1:63,360, 1968.

03341 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 E/5, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4741, scale 1:63,360, 1968.

03342 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 E/4, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4742, scale 1:63,360, 1968.

03343 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 D/13, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4743, scale 1:63,360, 1968.

03344 **Canada Geological Survey.** Aeromagnetic series, Lake Gillian North, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4744, scale 1:63,360, 1968.

03345 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 D/5, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4745, scale 1:63,360, 1968.

03346 **Canada Geological Survey.** Aeromagnetic series, Ipivtik Lake, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4746, scale 1:63,360, 1968.

03347 **Canada Geological Survey.** Aeromagnetic series, Omega Bay, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4747, scale 1:63,360, 1968.

03348 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 H/3, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4748, scale 1:63,360, 1968.

03349 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 E/14, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4749, scale 1:63,360, 1968.

03350 **Canada Geological Survey.** Aeromagnetic series, Nivalis Lake, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4750, scale 1:63,360, 1968.

03351 **Canada Geological Survey.** Aeromagnetic series, Lewis Glacier, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4751, scale 1:63,360, 1968.

03352 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 E/3, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4752, scale 1:63,360, 1968.

03353 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 D/14, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4753, scale 1:63,360, 1968.

03354 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 D/11, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4754, scale 1:63,360, 1968.

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03356 **Canada Geological Survey.** Aeromagnetic series, Piling Lake, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4756, scale 1:63,360, 1968.

03357 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 D/2, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4757, scale 1:63,360, 1968.

03358 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 D/7, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4758, scale 1:63,360, 1968.

03359 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 D/10, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4759, scale 1:63,360, 1968.

03360 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 D/15, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4760, scale 1:63,360, 1968.

03361 **Canada Geological Survey.** Aeromagnetic series, Barnes Ice Cap, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4761, scale 1:63,360, 1968.

03362 **Canada Geological Survey.** Aeromagnetic series, Bieler Lake West, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4762, scale 1:63,360, 1968.

03363 **Canada Geological Survey.** Aeromagnetic series, Conn Lake, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4763, scale 1:63,360, 1968.

03364 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 E/15, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4764, scale 1:63,360, 1968.

03365 **Canada Geological Survey.** Aeromagnetic series, Lac au Loup-Marin, Quebec: Canada Geol. Survey Geophysics Paper 4956, scale 1:63,360, 1968.

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03374 **Canada Geological Survey.** Aeromagnetic series, Sayabec, Quebec: Canada Geol. Survey Geophysics Paper 4985, scale 1:63,360, 1968.

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03378 **Canada Geological Survey.** Aeromagnetic series, Rivière Godbout, Quebec: Canada Geol. Survey Geophysics Paper 4989, scale 1:63,360, 1968.

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03380 **Canada Geological Survey.** Aeromagnetic series, Sainte-Félicité, Quebec: Canada Geol. Survey Geophysics Paper 5002, scale 1:63,360, 1968.

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03385 **Canada Geological Survey.** Aeromagnetic series, Cap-Chat, Quebec: Canada Geol. Survey Geophysics Paper 5019, scale 1:63,360, 1968.

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03388 **Canada Geological Survey.** Aeromagnetic series, Pointe Jambon, Quebec: Canada Geol. Survey Geophysics Paper 5022, scale 1:63,360, 1968.

03389 **Canada Geological Survey.** Aeromagnetic series, Escuminac, Quebec-New Brunswick: Canada Geol. Survey Geophysics Paper 5031, scale 1:63,360, 1968.

03390 **Canada Geological Survey.** Aeromagnetic series, Sainte-Anne-des Monts, Quebec: Canada Geol. Survey Geophysics Paper 5035, scale 1:63,360, 1968.

03391 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 G/8, Quebec: Canada Geol. Survey Geophysics Paper 5036, scale 1:63,360, 1968.

03392 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 G/9, Quebec: Canada Geol. Survey Geophysics Paper 5037, scale 1:63,360, 1968.

03393 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 G/16, Quebec: Canada Geol. Survey Geophysics Paper 5038, scale 1:63,360, 1968.

03394 **Canada Geological Survey.** Aeromagnetic series, Pointe Verte, Quebec–New Brunswick: Canada Geol. Survey Geophysics Paper 5047, scale 1:63,360, 1968.

03395 **Canada Geological Survey.** Aeromagnetic series, New Richmond, Quebec: Canada Geol. Survey Geophysics Paper 5048, scale 1:63,360, 1968.

03396 **Canada Geological Survey.** Aeromagnetic series, Lac McKay, Quebec: Canada Geol. Survey Geophysics Paper 5049, scale 1:63,360, 1968.

03397 **Canada Geological Survey.** Aeromagnetic series, Deville, Quebec: Canada Geol. Survey Geophysics Paper 5050, scale 1:63,360, 1968.

03398 **Canada Geological Survey.** Aeromagnetic series, Lac Madeleine, Quebec: Canada Geol. Survey Geophysics Paper 5051, scale 1:63,360, 1968.

03399 **Canada Geological Survey.** Aeromagnetic series, Mont-Louis, Quebec: Canada Geol. Survey Geophysics Paper 5052, scale 1:63,360, 1968.

03400 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 H/5, Quebec: Canada Geol. Survey Geophysics Paper 5053, scale 1:63,360, 1968.

03401 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 E/9, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4765, scale 1:63,360, 1968.

03402 **Canada Geological Survey.** Aeromagnetic series, Bieler Lake East, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4766, scale 1:63,360, 1968.

03403 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 E/1, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4767, scale 1:63,360, 1968.

03404 **Canada Geological Survey.** Aeromagnetic series, Gee Lake West, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4768, scale 1:63,360, 1968.

03405 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 D/9, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4769, scale 1:63,360, 1968.

03406 **Canada Geological Survey.** Aeromagnetic series, Flyaway Lake, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4770, scale 1:63,360, 1968.

03407 **Canada Geological Survey.** Aeromagnetic series, Sheet 37 D/1, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4771, scale 1:63,360, 1968.

03408 **Canada Geological Survey.** Aeromagnetic series, Sheet 27 C/5, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4773, scale 1:63,360, 1968.

03409 **Canada Geological Survey.** Aeromagnetic series, Generator Lake, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4774, scale 1:63,360, 1968.

03410 **Canada Geological Survey.** Aeromagnetic series, Sam Ford River, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 4775, scale 1:63,360, 1968.

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03412 **Canada Geological Survey.** Aeromagnetic series, Saint-Modeste, Quebec: Canada Geol. Survey Geophysics Paper 4932, scale 1:63,360, 1968.

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03416 **Canada Geological Survey.** Aeromagnetic series, Lac Cassette, Quebec: Canada Geol. Survey Geophysics Paper 4936, scale 1:63,360, 1968.

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03418 **Canada Geological Survey.** Aeromagnetic series, Lac le Barbier, Quebec: Canada Geol. Survey Geophysics Paper 4938, scale 1:63,360, 1968.

03419 **Canada Geological Survey.** Aeromagnetic series, Lac Sédillot, Quebec: Canada Geol. Survey Geophysics Paper 4939, scale 1:63,360, 1968.

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03421 **Canada Geological Survey.** Aeromagnetic series, Rimouski, Quebec: Canada Geol. Survey Geophysics Paper 4952, scale 1:63,360, 1968.

03422 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 C/10, Quebec: Canada Geol. Survey Geophysics Paper 4953, scale 1:63,360, 1968.

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03424 **Canada Geological Survey.** Aeromagnetic series, Lac Nipi, Quebec: Canada Geol. Survey Geophysics Paper 4955, scale 1:63,360, 1968.

03425 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 H/7, Quebec: Canada Geol. Survey Geophysics Paper 5087, scale 1:63,360, 1968.

03426 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 H/10, Quebec: Canada Geol. Survey Geophysics Paper 5088, scale 1:63,360, 1968.

03427 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 H/15, Quebec: Canada Geol. Survey Geophysics Paper 5089, scale 1:63,360, 1968.

03428 **Canada Geological Survey.** Aeromagnetic series, Miscou Island, New Brunswick: Canada Geol. Survey Geophysics Paper 5098, scale 1:63,360, 1968.

03429 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 A/1, Quebec-New Brunswick: Canada Geol. Survey Geophysics Paper 5099, scale 1:63,360, 1968.

03430 **Canada Geological Survey.** Aeromagnetic series, Cap D'espoir, Quebec: Canada Geol. Survey Geophysics Paper 5100, scale 1:63,360, 1968.

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03432 **Canada Geological Survey.** Aeromagnetic series, Gaspé, Quebec: Canada Geol. Survey Geophysics Paper 5102, scale 1:63,360, 1968.

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03434 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 H/8, Quebec: Canada Geol. Survey Geophysics Paper 5104, scale 1:63,360, 1968.

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03436 **Canada Geological Survey.** Aeromagnetic series, Port-Menier, Quebec: Canada Geol. Survey Geophysics Paper 5106, scale 1:63,360, 1968.

03443 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 H/12, Quebec: Canada Geol. Survey Geophysics Paper 5054, scale 1:63,360, 1968.

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03445 **Canada Geological Survey.** Aeromagnetic series, Grande-Anse, Quebec-New Brunswick: Canada Geol. Survey Geophysics Paper 5064, scale 1:63,360, 1968.

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03447 **Canada Geological Survey.** Aeromagnetic series, Honorat, Quebec: Canada Geol. Survey Geophysics Paper 5066, scale 1:63,360, 1968.

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03449 **Canada Geological Survey.** Aeromagnetic series, Lac York, Quebec: Canada Geol. Survey Geophysics Paper 5068, scale 1:63,360, 1968.

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03451 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 H/6, Quebec: Canada Geol. Survey Geophysics Paper 5070, scale 1:63,360, 1968.

03452 **Canada Geological Survey.** Aeromagnetic series, Sheet 22 H/11, Quebec: Canada Geol. Survey Geophysics Paper 5071, scale 1:63,360, 1968.

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03459 **Canada Geological Survey.** Aeromagnetic series, Cloridorme, Quebec: Canada Geol. Survey Geophysics Paper 5086, scale 1:63,360, 1968.

03800 **Canada Geological Survey.** Ship magnetometer and aeromagnetic series, Louisbourg, Cape Breton Island, Nova Scotia: Canada Geol. Survey Geophysics Paper 232, 2d edition, scale 1:63,360, 1968; originally published 1955.

03746 **Carroll, Robert L.** A ?diapsid (Reptilia) parietal from the Lower Permian of Oklahoma: Postilla, no. 117, 7 p., illus., 1968.

The discovery of a single isolated right parietal from the Lower Permian of Fort Sill, Oklahoma, suggests that ancestral eosuchians may occur in North American fauna. The parietal has a well-developed upper temporal opening, resembling that of the primitive South African diapsids. A comparison with *Araeoscelis* and *Youngopsis*, and the configuration of the rear skull table of millerosaurs and romeriids indicates that the bone usually identified as tabular in younginids is designated the supratemporal. The Fort Sill parietal may belong to a form structurally, if not phylogenetically, intermediate between primitive captorhinomorphs and eosuchians.—*from* Author's abstract

03922 **Carson, William P.** Development of flow cleavage in the Martinsburg Shale, Port Jervis South area (northern New Jersey): Tectonophysics, v. 5, no. 6, p. 531–541, illus., 1968.

In the Ordovician Martinsburg Shale in New Jersey and Pennsylvania, "nonmetamorphic" flow (slaty) cleavage has formed as a result of burial and compression of a water-bearing pelite (Maxwell, 1962). Macro and micro fabric evidence in the Port Jervis South area in northern New Jersey indicates that the formation of a progressively better developed flow cleavage across the regional strike of the Martinsburg is evidently related to increasing overburden, and therefore probable higher water pressures, in the original sequence.—Author's abstract

03314 **Carver, R. D.; Johnson, P. G.** Use of spark-source mass spectrograph for the general analysis of geological samples [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 369, 1968.

Carver, R. D. *See* Bailey, C. A. 03322

03622 **Casshyap, Satyendra M.** Huronian stratigraphy and paleocurrent analysis in the Espanola–Willisville area, Sudbury district, Ontario, Canada: Jour. Sed. Petrology, v. 38, no. 3, p. 920–942, illus., tables, 1968.

The bulk of the strata are arenaceous: medium- to fine-grained, submature, subarkose to arkose; some are calcareous (Espanola Formation). The Bruce and Gowganda Formations are pebbly, conglomeratic muddy sandstone in which the "matrix" generally is fine-grained subarkose, locally lithic. Paleocurrent study based on cross-bedding azimuths and dimensional fabric of phenoclasts suggests that the sediment transport for all the Huronian formations in this area was persistently from the north-northeast and north-northwest quadrants. Most arenaceous rock types are coastal plain fluvial deposits probably laid down by a system of migrating meandering rivers. The supermature quartzarenite of the upper Lorrain represents deposition in the turbulent shore zone. The Bruce, like the Gowganda Formation, may well be of glacial origin.—*from* Author's abstract

Castillón B., M. *See* Contreras V., H. 03439

Cavaroc, Victor V., Jr. *See* Ferm, John C. 03253

03616 **Chamberlain, J. A.** Some geochemical factors in the formation of nickel sulphides in ultramafic rocks [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 570, 1968.

03723 **Chapman, Rodger H.; Bishop, Charles C.** (compilers). Bouguer gravity map of California—San Francisco sheet: San Francisco, Calif., California Div. Mines and Geology, scale 1:250,000, separate text, 1968.

Bouguer anomaly values, contoured with a 5 mgal interval for land areas, and 10 and 20 mgal for ocean areas, were overprinted on the geologic map, Olaf P. Jenkins edition (1961). The land portion is within the central California Coast Ranges. The regional gravity field decreases to the northeast at about 2 mgal per mi. Bouguer gravity values decrease from about +230 mgal in the ocean in the southwestern part to a minimum of less than −30 mgal in the Berkeley Hills; the decrease is due to difference in density between oceanic and continental crustal rocks and by an eastward increase in thickness of the crust. Many local positive anomalies are associated with exposures of relatively dense rocks of the Franciscan Formation, or granitic and metamorphic rocks; negative anomalies are associated with Cenozoic sedimentary rocks.—MCM

03724 **Chapman, Rodger H.; Bishop, Charles C.** (compilers). Bouguer gravity map of California—Alturas sheet: San Francisco, Calif., California Div. Mines and Geology, scale 1:250,000, separate text, 1968.

Bouguer gravity anomaly values were contoured on a 5 mgal interval and overprinted on the geologic map, Olaf P. Jenkins edition (1958). The Alturas sheet occupies portions of four geomorphic provinces: Klamath Mts., Cascade Range, Modoc Plateau, and Basin-Ranges. The regional gravity field in northeastern California decreases from about −120 mgal in the southwestern corner of the map area to less than −160 mgal in the northeastern corner, probably related to an eastward thickening of the continental crust. Some local gravity anomalies are associated with exposures of particular rock types, such as pre-Tertiary basement rocks, Tertiary intrusives, and Quaternary sediments. A number of positive anomalies in areas covered by Tertiary and Quaternary volcanic rocks show no obvious relation to rock type. The eastern half of the map-area shows two broad gravity depressions with amplitudes that reach at least 20 mgal.—MCM

Chapman, S. L. *See* Syers, J. K. 03933

03908 **Chapple, William M.** The analysis of strain in deformed rocks—Discussion [of paper by B. E. Hobbs, and J. L. Talbot, 1966]: Jour. Geology, v. 76, no. 4, p. 491–494, illus., 1968.

Hobbs and Talbot's (ibid., v. 74, p. 500–5.3) strain analysis from brachiopod deformation is re-assessed by Chapple, who points out that two originally perpendicular line-pairs within a bedding plane in a region of homogeneous strain suffice to define the orientation and magnitude of the strain ellipse within the bedding; no assumptions about the orientation of the ellipse are needed. The pertinent equation is that of Brace (1961), here illustrated by a numerical example. For brachiopod deformation, see also Ramsay, J. G. (1967).—BFL

Charbonneau, B. W. *See* Morley, L. W. 03771

03906 **Chaudhuri, Sambhudas; Faure, Gunter.** Rubidium-strontium age of the Mount Bohemia intrusion of Michigan: Jour. Geology, v. 76, no. 4, p. 488–490, illus., table, 1968.

On the basis of the whole-rock Rb-Sr isochron slope for five samples, the Mount Bohemia intrusion is 1130±35 m.y. old, with an initial Sr-87/Sr-86 ratio of 0.7045±0.001. It may thus have been essentially contemporaneous and consanguinous with the Duluth gabbro, previously determined by similar methods (Faure, 1964) as 1142±25 m.y. old, initial Sr-87/Sr-86 ratio 0.7050±0.0005.—REW

03773 **Chenoweth, Philip A.** Early Paleozoic (Arbuckle) overlap, southern Mid-Continent, United States: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1670–1688, illus., 1968.

Dresbachian (early Late Cambrian) seas overlapped basement only in eastern Kansas, eastern Oklahoma, and along the axis of the southern Oklahoma geosyncline. Precambrian and Cambrian basement rocks were peneplaned prior to submergence, but scattered monadnocks remained. Late Dresbachian withdrawal of the sea was rapid and widespread. Regression prevailed during Franconian time except in the geosyncline. Deep Trempealeauan transgression inundated all but

north-central Kansas and the highest Oklahoma islands; emergence followed. Ordovician seas overlapped all older strata, finally submerging the last remnants of the Precambrian basement. Lines of pinchout, facies change, and overlap produced potential stratigraphic traps.—*from* Author's abstract

03810 **Cherry, J. T.; Larson, D. B.; Rapp, E. G.** A unique description of the failure of a brittle material: Internat.Jour. Rock Mechanics and Mining Sci., v. 5, no. 5, p. 455–463, illus., 1968.

A failure model is presented which combines both 'shear' and 'tensile' failure into a single invariant expression. The usefulness of the expression lies in its ability to consistently describe material failure produced by the compression, extension, and hollowtorsion laboratory tests. A correct extension of the failure surface back to zero means stress is now possible. The failure law is used to calculate the extent of cracking [in granite, dolomite, and salt] from three nuclear experiments.—*from* Authors' abstract

03617 **Chesworth, Ward.** Metamorphism in the Haliburton Highlands of Ontario [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 570–571, 1968.

03542 **Chilingarian, George V.; Rieke, Herman H., 3d.** Data on consolidation of fine-grained sediments: Jour. Sed. Petrology, v. 38, no. 3, p. 811–816, illus., tables, 1968.

Previous research is reviewed, and additional experimental data are presented. An analysis of pressure vs. moisture content curves for these sediments has lead to the overall conclusion that upward deviations of the curve from linearity are caused by the squeezing out of non-oriented water first. These deviations occur at pressures corresponding to about 20–25 percent remaining moisture content for kaolinite, and about 50–70 percent for montmorillonite, that is, at pressures where the chemistry of the squeezed-out solutions begins to change appreciably. The experimental results also indicate that the salinity of the interstitial solutions in shales should be less than that of water in associated sandstones, assuming that water was squeezed from the shale into the sandstone.—*from* Authors' abstract

03921 **Chinnery, Michael A.; Petrak, John A.** The dislocation fault model with a variable discontinuity: Tectonophysics, v. 5, no. 6, p. 513–529, illus., 1968.

The mathematical model of the vertical strike-slip faults used in previous investigations is extended to include a net displacement that varies over the fault face. The variation is chosen so as to remove the stress singularity that occurs at the edge of the fault plane in some earlier models. The effect of the new model on conclusions reached in the past is discussed. It is shown that small movements at depth affect surface displacements very little, and estimates of fault depth derived from these displacements are likely to be minimum values. Also, even though displacement on a fault decays quite slowly towards its end, important effects are still to be associated with accumulations of stress and strain near the end of the fault. Calculations of the stress drop that accompanies faulting are changed very little by introduction of the new model.—Authors' abstract

03661 **Church, C. C.** Dr. Joseph John Graham, 1909–1967: Cushman Found. Foram. Research Contr., v. 19, pt. 3, p. 81–83, 1968.

Churkin, Michael, Jr. *See* Gryc, George. 03799

Clabaugh, Patricia S. *See* Muehlberger, William R. 03466

Clayton, R. N. *See* Syers, J. K. 03933

03654 **Cleaves, Emery T.** Piedmont and Coastal Plain geology along the Susquehanna Aqueduct, Baltimore to Aberdeen, Maryland: Maryland Geol. Survey Rept. Inv. 8, 45 p., illus., tables, 1968.

This trench crosses Lower Cretaceous and Quaternary sediments, and older crystalline rocks mantled by structured and massive saprolite; banks failed in

structured saprolite, along planar structures such as joints, and in water-saturated sand. Focal points of weathering are joints in equigranular rocks; textural and mineral layering are in gneisses and schists. Evidence that the upper part of the saprolite formed before deposition of Coastal Plain sediments is in its extent beneath them, truncation by them, particles in basic sands and gravels, and occurrence of lag gravels at contacts. Residual boulders and rock pinnacles in gabbro saprolite were excavation problems, as were abrupt lithologic changes in the Piedmont derived fluvio-deltaic sediments of the Potomac Group, and the valley gravels. Loam pockets and saturated sand were sensitive to vibration.—GDC

03273 **Coats, Colin J. A.** Serpentine minerals from Manitoba: Canadian Mineralogist, v. 9, pt. 3, p. 322–347, illus., tables, 1968.

Serpentinized ultramafic rocks of Aphebian age occur along a northeasterly trending zone of complexly faulted gneissic rocks in the Setting Lake–Moak Lake region of central Manitoba. The predominant serpentine mineral in these rocks is a fibrous variety which can only be satisfactorily indexed on the basis of a 3-layer structure. The derived 3-layer orthorhombic, pseudohexagonal cell has dimensions of a=5.346 A, b=9.205 A and c=21.93 A. Antigorite and lizardite from the area have also been identified by optical X-ray diffraction and differential thermal analysis methods. Additional occurrences of antigorite from Oxford Lake, Carrot River, Knee Lake and Island Lake in Manitoba and Lancaster County in Pennsylvania are described and compared with the Caracas antigorite.—Author's abstract

03282 **Cody, R. D.** Spectrographic determination of boron in clay shales: Appl. Spectroscopy, v. 22, no. 4, p. 272–274, illus., tables, 1968.

Cobalt has been found to be an acceptable internal standard for the spectrographic determination of boron in shale. Its use leads to acceptable agreement between spectrochemical and wet-chemical analyses, and has given an average coefficient of variation of ±3.57 percent for 57 clay samples.—Author's abstract

03892 **Cohee, George V.** Holocene replaces Recent in nomenclature usage of the U.S. Geological Survey: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 852, 1968.

The term "Holocene" replaces "Recent" in the nomenclature of the U.S. Geological Survey, and is considered to be of series rank.—WCC

Coleman, James M. *See* Morgan, James P. 03328

Colvin, John M., Jr. *See* Wilson, Charles W., Jr. 0373

03885 **Committee on Education.** Guidelines for the establishment of a university program of excellence in the geophysical sciences: Am. Geophys. Union Trans., v. 49, no. 2, p. 465–468, 1968.

To meet the anticipated increased need for highly trained personnel in geophysics, it is desirable that additional universities undertake programs of excellence in one or more of the geophysical sciences. Broad guidelines are presented to provide information that will be helpful to universities considering the establishment of programs leading to excellence within a decade. The guidelines are directed primarily at universities which already offer graduate degrees in physics or engineering science. It is hoped that the guidelines will also be helpful to undergraduate colleges that wish to prepare students for graduate work in one of the geophysical sciences.—*from* Author's abstract

03284 **Conselman, Frank B.** Factors in exploration for nonassociated natural gas, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1983–1989, 1968.

Natural gas may originate entirely apart from oil. Significant data regarding methane, the principal constituent of natural gas, are available from coal mines and metal mines cutting carboniferous sediments. Gases originating with oil may separate because of important physical and chemical differences between the two

fluids. Migration need not be over long distances; there are many examples of commercial gas fields caused by short-range segregation. New field discoveries in unlikely reservoirs, restudy of the old carbon-ratio idea, and information from artificial gas caps in underground storage suggest that gas-finding may involve more than normal oil-finding criteria. New definitions of reservoir and source rock may be needed, as well as techniques for the detection of gas when drilled.—*from* Author's abstract

03439 **Contreras V., H.; Castillón B., M.** Morphology and origin of salt domes of Isthmus of Tehuantepec, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 244–260, illus., 1968.

The salt of the Isthmian basin of Tehuantepec is in at least five masses from 10 to 25 km wide, from 12 to 30 km long, and within 50 m of the surface. Some domes not obviously related to the masses are present. Most of the salt structures have a cap rock of anhydrite and a little gypsum; the thickness varies, and a few have sulfur present. The upper part of the salt is latest Jurassic or earliest Cretaceous, palynologically. The lower age limit is not known but could be as old as Triassic. The thickness of the salt in the masses may be up to 5,000 m, but the original depositional thickness is unknown. The salt was emplaced by the isostatic effect of overlying Cretaceous sediments.—*from* Authors' abstract

03851 **Cook, Douglas R.** To find more ore, use better exploration techniques: Mining Eng., v. 20, no. 7, p. 156–160, illus., tables, 1968.

Rising exploration costs and the need to develop new metal resources justify a critical review of procedures used in the search for ore deposits. Weaknesses evident in the use of exploration data include the unreliability of measurements, poor interpretation of results, negative use of certain data, improper selection of techniques, acquisition of irrelevant or useless information, and sometimes the unrealistic desire for technological breakthroughs. Present exploration techniques can be improved by the use of multiple working hypotheses, improvement in quality of exploration data, better discrimination in selection of the type of geosurvey used, greater recognition of variables affecting interpretation of exploration data, use of techniques in a positive sense, and not discounting the importance of geology. Basic considerations necessary for an effective exploration program are discussed and tabulated.—MAC

03845 **Corbett, J. D.** Geophysical exploration continues its rapid pace: Mining Eng., v. 20, no. 2, p. 68–72, illus., 1968.

The use of geophysics in mineral-deposit exploration continued to expand in 1967. The two most important technological advancements were the development of spectrometer scintillation equipment, and the application of remote-sensing equipment to terrestrial prospecting. Of the more routine prospecting methods, induced polarization continued to be the most popular worldwide. The use of geophysics on a regional scale has assumed an increasingly important role, particularly among governmental agencies. Overall geophysical activity by private companies was up as much as 25 percent over 1966. Geophysical techniques are also finding increased application in ground-water studies. Geophysical research programs are directed mainly towards regional or crustal studies or towards physical-property studies.—MAC

Couch, R. W. *See* Dehlinger, P. 03627

Court, James. *See* Goldman, Charles R. 03688

03283 **Cowgill, Ursula M.** Method to determine all detectable exchangeable cations using X-ray emission and optical emission spectroscopy [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 368, 1968.

03895 **Cowie, J. W.** Lower Cambrian faunas from Ellesmere Island, District of Franklin, *in* Contributions to Canadian palaeontology: Canada Geol. Survey Bull. 163, p. 3–27, illus., 1968.

This report describes, in stratigraphic perspective, a Lower Cambrian fauna from Ellesmere Island comprising hyolithids and trilobites. The trilobites are assigned to five genera and include two new species.—Author's abstract

03835 **Crelling, John C.; Dutcher, Russell R.** A petrologic study of a thermally altered coal from the Purgatoire River valley of Colorado: Geol. Soc. America Bull., v. 79, no. 10, p. 1375–1385, illus., tables, 1968.

Petrographic, mineralogic, chemical, and reflectance characteristics of a thermally altered 21-inch coal seam six feet above an 8-ft igneous sill have been changed as follows: (1) exinoids and resinoids altered beyond point of recognition, vitrinoids altered in color and structure, cell cavities in fusinoids generally filled with calcite, contorted bedding formed, flowage structure in natural coke, mosaic structure and vesiculation common throughout seam; (2) only quartz, kaolinite, siderite, calcite, and ferric sulfate were identified by X-ray examination (no cristobalite, mullite, or pyrophyllite); (3) volatile matter increases as distance from the intrusion decreases; and (4) mean reflectance values increase toward the sill. A temperature gradient, from <600°C at base to >375° at top, existed across the coal seam during thermal alteration.—HCW

03682 **Cruickshank, Michael J.** Mining and mineral recovery, Chap. 11 *in* UnderSea Technology—Handbook, Directory, 1968: Arlington, Va., Compass Pubs., p. A81–A90, illus., tables, 1968.

Current activities in mining and mineral recovery from the ocean are presented in summary and in tabular form. Three major classes of deposits are found in the marine environment: dissolved minerals in ocean waters; unconsolidated deposits on beaches, continental shelf, or sea floor; and consolidated deposits in bedrock underlying the seas. The greater part of the exploration has been directed toward the second. Techniques are the same for all types and include platforms, positioning, geophysical profiling, and sampling, of which the latter most needs improvement. Offshore mineral exploration activities, developments in submarine hardware, sea water mineral extraction plants, and offshore dredging operations all are tabulated for 1967–68. Coal, sulfur, and iron have been mined under the sea for years.—ESL

Cunningham, Charles G., Jr. *See* Foose, Richard M. 03860

Curtis, Bruce F. *See* Beebe, B. Warren. 03332

Curtis, Bruce F. *See* Beebe, B. W. 03477

03502 **Curtis, Graham R.** Nichols field, Kiowa County, Kansas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1582–1587, illus., 1968.

Gas was discovered in the Nichols field, in south-central Kiowa County, Kansas, in 1955. Oil was discovered in 1956. The main reservoir is in Mississippian chert (Osage). Combination structural and stratigraphic trapping is responsible for the accumulations. Cumulative gas production to January 1, 1967, was 17,401,647 Mcf. Cumulative oil production to that date was 5,192,455 bbls.—Author's abstract

03276 **Cuttitta, Frank; Rose, Harry J., Jr.** Slope-ratio technique for the determination of trace elements by X-ray spectroscopy—A new approach to matrix problems: Appl. Spectroscopy, v. 22, no. 4, p. 321–324, illus., table, 1968.

A new approach to solving matrix problems in X-ray fluorescence analysis of trace elements has been applied to determination of bromine in saline waters and zinc in silicates. Marked matrix effects are minimized by dilution, and the problem of variable backgrounds due to residual matrix effects is solved by using a slope-ratio technique, in which the slope of a standard curve prepared from pure solutions is compared with that of spiked samples. The ratio of the slopes of these curves permits calculation of an adjusted background which does not significantly differ from that of an absorbent impregnated with the sample matrix free of the element sought. The excellent agreement of zinc and bromine data with analytical results

obtained by conventional methods suggests that the technique can be used for determination of other trace constituents in geologic materials.—*from* Authors' abstract

03311 **Cuttitta, Frank; Rose, Harry J., Jr.** Micro X-ray fluorescence spectroscopy—Selected geochemical applications [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 369, 1968.

D'Anglejan, B. F. *See* Macintyre, I. G. 03562

03618 **Danner, Wilbert R.** Origin of the siderite coprolite-like bodies of the Wilkes formation, Late Miocene of southwestern Washington [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 571, 1968.

Darmstetter, J. C. *See* Frensley, Robert W. 03500

03589 **Davidson, A.** Nepheline K-feldspar intergrowth from Kaminak Lake, N.W.T. [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 571, 1968.

03733 **Davis, D. J.** Robert Bruce Bradley, 6 August 1943–3 September 1967: Ontario Geography, no. 2, p. 1–2, portrait, 1968.

03475 **Davis, Ralph E.** The story of natural gas, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 2137–2148, illus., tables, 1968.

Natural gas and oil, generally found in sedimentary rocks, have a similar organic origin. The greatest volumes of gas and oil are in Tertiary and Cretaceous rocks. The fields are commonly found in sedimentary basins, of which there are many. Most gas comes from a few large fields although there are thousands of small ones. There are less than 100 major gas fields in the United States which have over 1 trillion cu ft gas in reserve. The average size of gas field found has diminished over the years. Fields are becoming rarer and costs are rising. Gas reserves are still 281 trillion cu ft even though 244 trillion cu ft have been used, and 500 trillion cu ft are still potential finds, most of which will come from the Gulf Coast, Permian basin, and Rocky Mountain region.—HRC

03532 **Davis, Richard A., Jr.** Algal stromatolites composed of quartz sandstone: Jour. Sed. Petrology, v. 38, no. 3, p. 953–955, illus.y1968.

Algal stromatolites composed of quartz sandstone, which are heretofore undescribed from ancient rocks, are present in the New Richmond Sandstone (L. Ord.) in southeastern Minnesota. Although these stromatolites resemble their common carbonate counterparts in the field, the stromatolite structure is at best obscure in thin section. These quartz sandstone stromatolites correlate with similar carbonate structures nearby and probably represent an environment of deposition at or near the boundary between a shallow quartz sand environment and an intertidal carbonate environment.—Author's abstract

03633 **Davis, Richard Arnold; Campbell, Carlyle B.** An orthocerid cephalopod from the Cherokee Group of Marion County, Iowa: Iowa Acad. Sci. Proc. 1966, v. 73, p. 279–284, illus., 1968.

Specimens of *Pseudorthoceras knoxense* (McChesney) occurring in the lower part of the Cherokee Group in Marion County, Iowa, possess body chambers. The shell of these body chambers is distinctly thickened with the thickest portion of the callus on the venter. No reasonably complete peristome is preserved, but growth lines on the body chamber indicate the presence of only a broad, shallow reëntrant and a broad, shallow salient.—Authors' abstract

Dean, John A. *See* Syty, Augusta. 03288

DeCarli, P. S. *See* Wong, J. Y. 03925

03627 **Dehlinger, P.; Couch, R. W.; Gemperle, M.** Continental and oceanic structure from the Oregon coast westward across the Juan de Fuca Ridge, *in* Symposium on continental margins and island arcs, 3d, Zurich, 1967: Canadian Jour. Earth Sci., v. 5, no. 4, pt. 2, p. 1079–1090, illus., 1968.

Seismic and gravity subcrustal sections from the Tufts Abyssal Plain west of the Oregon coast to southern Idaho are given; equilibrium is attained. Mantle depths west of Juan de Fuca ridge, in eastern Oregon, and in southern Idaho are normal, but under the ridge and west of the coast the mantle is shallow and densities are below normal to a considerable depth. Two mantle structures, considered possible, are discussed. Across the continental margin, the Moho dips sharply under the continents, being typical (18 km) near the coast. The discontinuity is relatively shallow under western Oregon, and the corresponding mantle is described in terms of apparent velocity and density.—*from* Authors' abstract

deMille, George. *See* Gould, Don B. 03438

Demirel, T. *See* Senich, Donald. 03630

Denman, Orval. *See* Blanchard, K. S. 03508

Dennen, W. H. *See* Blackburn, W. H. 03258

Dennis, Howard W. *See* Drummond, Robert R. 03736

Dennis, Leonard S. *See* Taylor, Patrick. 03812

03887 **Dessler, A. J.** The role of space science in graduate education: Am. Geophys. Union Trans., v. 49, no. 3, p. 549–554, illus., 1968.

Space science, covering the broadest aspects of the behavior of matter on a cosmic scale, exerts a unifying effect on science and will therefore become of increasing importance for graduate education. The establishment of a space science program on a university campus requires hardly more than a plan to do so. The program, tied to graduate education, can be kept relatively low in cost by utilizing in part the data available in the NASA National Space Science Data Center.—*from* Author's summary

03744 **Detling, LeRoy E.** Historical background of the flora of the Pacific Northwest: Oregon Univ. Mus. Nat. History Bull. 13, 57 p., illus., tables, 1968.

The modern flora of the Pacific Northwest is characterized by associations which show affinities to floras now occupying widely separated areas (Eurasia, South and Central America) and to floras shown by paleobotanical evidence to have occupied all these areas, but particularly the American West. Distinct distribution patterns, both in time and space, manifest themselves. These patterns are and have been influenced by topographic and climatic changes from the Cretaceous to the present. Three principal sources of associations are evident: evolution *in situ*; northern regions as shown in the Arcto–Tertiary Geoflora; western Mexico and the southwestern United States as shown in the Madro–Tertiary Geoflora.—Author's abstract

03826 **DeVoto, Richard H.** Quaternary history of the Rocky Mountain Arsenal and environs, Adams County, Colorado, *in* Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well, Pt. A: Colorado School Mines Quart., v. 63, no. 1, p. 113–127, illus., 1968.

The Quaternary history of the Rocky Mountain Arsenal area has been a series of cycles of physical processes in the following order: (1) stream erosion, (2) alluviation, (3) deflation and aolian deposition, and (4) slope stability and soil development. Remnants of nine of these cycles have been preserved in the vicinity of the Arsenal. No evidence of Recent faulting is apparent in the surficial geology of the area. The alignment and coincidence of the modern fault zone and several pre–Wisconsin Quaternary geomorphic features indicate that the northwest-trending zone of modern fault displacements could have been the locus of Pleistocene fault

displacements. However, the fault zone probably was quiescent during the Recent until injection of fluids into the Arsenal well.—*from* Author's abstract

03659 **Dial, D. C.** Water-level trends in southeastern Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 22, 11 p., illus., 1968.

Present water-level trends in southeastern Louisiana indicate relatively large declines in deep aquifers and little or no declines in shallow aquifers. In deep aquifers declining water levels range from five feet per year in western Livingston Parish to one foot per year in areas more remote from heavy pumping. Moderate withdrawals from deep aquifers, such as those at Hammond and Slidell, have caused water-level declines of almost two feet per year. Much of southeastern Louisiana's usable ground-water resource flows to waste from abandoned or unused wells, which reduces artesian pressures and thus contributes to water-level declines.—Author's abstract

03527 **Dickinson, Kendell A.** Petrology of the Buckner Formation in adjacent parts of Texas, Louisiana, and Arkansas: Jour. Sed. Petrology, v. 38, no. 2, p. 555–567, illus., 1968.

This is an evaporitic mudstone unit of Late Jurassic age present only in the subsurface; two members, an upper and a lower, are recognized. Nodular anhydritic mudstone and nodular anhydrite are the most common rock types. The nodules are lathy anhydrite occurring in a groundmass of blocky to anhedral grains. The matrix is mudstone, with illite and chlorite. Laminated anhydrite is the next common type. The Buckner was deposited in basins paralleling the Gulf Coast embayment margin. Salt-cored anticlines along the seaward margins restricted the circulation. In general, the sea was regressing during the time of the Buckner deposition. Nodular anhydrite is associated with brackish-water fossils and was probably deposited as gypsum. Microgranular anhydrite is associated with rock salt and is here considered to be primary.—*from* Author's abstract

03942 **Dietz, Robert S.** Reply [to "Arthur Holmes—Originator of spreading ocean floor hypothesis," by A. A. Meyerhoff (1968)]: Jour. Geophys. Research, v. 73, no. 20, p. 6567, 1968.

Arthur Holmes did not father sea-floor spreading, as Meyerhoff claims (ibid., p. 6563–6565), although perhaps in some ways he anticipated it. Hess deserves full credit for the concept.—DBV

Dietz, W. P. *See* Ruhe, R. V. 03521

Dimsdale, B. *See* Taylor, R. E. 03719

03246 **Dineley, D. L.; Williams, B. P. J.** Sedimentation and paleoecology of the Devonian Escuminac Formation and related strata, Escuminac Bay, Quebec, *in* Late Paleozoic and Mesozoic continental sedimentation, northeastern North America—A symposium: Geol. Soc. America Spec. Paper 106, p. 241–264, illus., table, 1968.

Stratigraphy revision in this area retains the Escuminac and Fleurant Formations within the Upper Devonian; the unconformably underlying Pirate Cove Formation is regarded as Lower or Middle Devonian. Sediments of all three were deposited in a complex of alluvial fans, flood plains, river channels and lakes. The Pirate Cove, with angular limestone-clast "fanglomerates", channeled and ripple-bedded sandstones and shales, is transitional into underlying "Gaspé Sandstones". In contrast, the Fleurant, a mixed roundstone conglomerate, is associated with the overlying Escuminac fish-bearing beds. The Escuminac Formation comprises alternating thin sandstones and shale units with both varved and pyritiferous horizons. A fresh- to brackish-water lacustrine regime is suggested, with periodic turbid currents, and a unimodal current pattern from east to west.—GDC

03737 **Dionne, Jean-Claude.** Carte morpho-sédimentologique de la région des Trois-Pistoles [with English and Polish abs.]: Rev. Géographie Montréal, v. 22, no. 1, p. 55–64, illus., 1968.

The map illustrates morphological and sedimentological aspects of the south coast of the St. Lawrence Estuary. Thick Quaternary deposits have buried the pre-glacial Appalachian topography. Raised beaches and abandoned sea cliffs indicate two main periods of relative stability during the gradual withdrawal of the post-glacial sea which covered the land up to 140 m. The delta of the former Trois-Pistoles River, built in the Trois-Pistoles sea at the end of the glacial episode, is apparently slightly older than the St. Antonin moraine found farther west. The map provides information about soils and geology for agricultural purposes, and is based upon intensive photo-interpretation and field work.—*from* Author's abstract

Dionne, Jean-Claude. *See* Laverdière, Camille. 03738

03327 **Dobbin, Carroll E.** Geology of natural gases rich in helium, nitrogen, carbon dioxide, and hydrogen sulfide, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1957-1969, illus., tables, 1968.

Although natural gases may contain up to 10 percent He throughout North America, the greatest concentration of rich gas is in the Permian carbonate rocks in the Texas and Oklahoma Panhandles and in southwestern Kansas. At Pinta dome, in Ariz., a Permian sandstone yields gas containing 8.0 percent He. In Saskatchewan, the richest known helium gas—1-2 percent—is in Ordovician and Cambrian beds. The closeness of the rich helium gas to the basement suggests derivation from decay and subsequent vertical movement of radioactive elements, such as uranium and thorium, in those rocks. Helium-rich gas from deep wells generally is rich in nitrogen, but not in every case. Deep wells with gas rich in CO_2 are chiefly in the western United States and the Pánuco district, Mexico, in Mississippian to Cretaceous rocks. Gas rich in H_2S is chiefly from carbonate rocks.—*from* Author's abstract

03732 **Dolling, Ray.** Occurrence of pools and riffles—An element in the quasi-equilibrium state of river channels: Ontario Geography, no. 2, p. 3-11, illus., tables, 1968.

Criteria that can be used to distinguish between pools and riffles, and the possibility that they are related to energy distribution in the stream are examined. Sites chosen for analysis are on the lower reaches of Bronte Creek in south-central Ontario where a pool-riffle sequence was well-defined at lower water; 30 channel cross sections were studied. The dimensionless velocity to depth ratio was chosen as the best criterion to use in the analysis; low values indicate pools, and high values, riffles. It is proposed that occurrence of pools and riffles may be a mechanism by which dynamic equilibrium is maintained. A statistical model was worked out involving the velocity to depth ratio, power per unit width, and resistance due to friction. It has excellent predictive and explanatory value but the state at a time of active erosion remains to be demonstrated.—ESL

Donahue, Jack. *See* Krinsley, David. 03547

03319 **Dooley, John A.; Young, Myron; Gorrell, James; Polishuk, Paul.** Computer program development for automatic processing of activation analysis data [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 371, 1968.

03881 **Douglas, John G.** Richard John Hughes, Jr. (1915-1968): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1804-1806, portrait, 1968.

03643 **Drake, Charles L.; Ewing, John I.; Stockard, Henry.** The continental margin of the eastern United States, *in* Symposium on continental margins and island arcs, 3d, Zurich, 1967: Canadian Jour. Earth Sci., v. 5, no. 4, pt. 2, p. 993-1010, illus., 1968.

Geophysical and geological data of many types are now available from the continental margin of the eastern United States. These include seismic reflection and refraction data, gravity and magnetic measurements, cores of sediments and dredge hauls of rocks, underwater photographs, echo sounding data, and a large body of surface and subsurface geological data from the adjacent land. Major

differences in the sedimentary pattern and sedimentary types occur from north to south and reflect not only source differences but also differences in means of transport and deposition. The data indicate a continuity of structure from Newfoundland to the Bahamas, interrupted only by the Kelvin–New England seamount group and associated structures ashore. They suggest that the ocean basin west of Bermuda is at least as old as Paleozoic.—Authors' abstract

03736 **Drummond, Robert R.; Dennis, Howard W.** Qualifying relief terms: Prof. Geographer, v. 20, no. 5, p. 326–332, 1968.

Because the exact meaning of the word relief is often obscure, there has been a proliferation of qualifying expressions. References are given to 59 definitions of 28 qualifying relief terms that have appeared in professional papers and journals in the period 1945–1967.—LLR

03320 **Dryer, H. T.** Performance of the rhodium target tube in X-ray quantometers [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 378, 1968.

03834 **Duffield, Wendell A.** The petrology and structure of the El Pinal tonalite, Baja California, Mexico: Geol. Soc. America Bull., v. 79, no. 10, p. 1351–1374, illus., geol. map, 1968.

The pluton occupies about 190 sq km in the western Sierra Juarez; it is part of the southern California batholith. Three concentric zones were mapped. The texture grades from hypidiomorphic granular in the center of pluton to protoclastic and locally cataclastic at the contact. Concentric foliation, generally defined by flattened inclusions and biotite grains, ranges from gentle in center through vertical to steeply outwardyparallel to contact, at the margin. Lineation, defined by elongate inclusions and biotite, plunges down foliation. Biaxial tabular plagioclase crystals tend to lie with (010) parallel to foliation and *a* parallel to lineations, an orientation probably caused by the effect of magmatic flow on crystals that were at the time elongate parallel to *a* or *c*. Total structure is best explained by an initial 360° ring fracture in roof rocks.—RAL

Dunham, A. C. *See* Kaye, M. J. 03556

03858 **Dunlop, D. J.** Monodomain theory—Experimental verification: Science, v. 162, no. 3850, p. 256–258, illus., 1968.

The Néel thermal-activation theory of remanence in monodomain grains has been verified quantitatively in experiments on four ferrite micropowders and two natural rocks. Magnetization and demagnetization curves of thermal, isothermal, viscous, and anhysteretic remanences can all be predicted with reasonable accuracy when the Néel theory is generalized to include effects of grain interaction. Results with the natural materials indicate that interacting, single-domain grains or regions are the carriers of the magnetically hard natural remanence of some paleomagnetic rocks.—Author's abstract

Dupzyk, R. J. *See* Bailey, C. A. 03322

Dutcher, Russell R. *See* Crelling, John C. 03835

Dutro, J. T., Jr. *See* Gryc, George. 03799

Duty, Robert S., Jr. *See* Pollard, Jack C. 03869

Eastwood, William P. *See* Anderson, Sidney B. 03511

03531 **Ehlmann, Arthur J.** Clay mineralogy of weathered products and of river sediments, Puerto Rico: Jour. Sed. Petrology, v. 38, no. 3, p. 885–894, illus., tables, 1968.

The weathering of volcanic rocks in a humid area results in a soil of halloysite, gibbsite, and quartz, whereas in more arid areas weathering produces montmorillonite. The rivers of Puerto Rico reflect the climatic conditions in their

watersheds insofar as the characteristic top-soil components in their load is concerned. Because of the small volume of clay relative to the larger volume of mineralogically unstable volcanic sand in the rivers, however, the bulk sediment being deposited off-shore provides only slight indication of climatic conditions on-shore. This observation indicates that ancient source area climatic conditions inferred from clay fractions of sedimentary rocks are always tenuous, particularly in view of the fact that some (if not all) of the clay fraction of a rock may be derived from altered unstable sand grains.—*from* Author's abstract

Elenbaas, J. R. *See* Vary, J. A. 03494

03751 **Elevatorski, E. A.** California fluorspar: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 9, p. 127–130, illus., 1968.

The mineralogy, mode of occurrence, and mining industry of fluorspar in California is described. Analyses of representative mine-run samples are given, together with brief descriptions of individual deposits, additional prospects, and new discoveries.—MST

03476 **Elliott, Martin A.; vonFredersdorff, C. G.** Rational analysis of future rate of natural gas production, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 2171–2184, illus., tables, 1968.

Analysis of the 1945–1957 gas-production gave a quantitative correlation between cumulated production, P, and cumulated discoveries D, of the form $P2\ KD^n$ where K and n are constants. The recent trend of life index, L, with time, t, was represented by the equation of a hyperbola, $(L-A)(t-t_o+t_i)=C$, where t_o is a base year, A is the life index asymptote, and t_i and C are constants. Combination of these correlations with the definition of rate of gas production, $r_p=R/L$, where R is proved reserves, formulates equations which closely fit past yearly production data. Computation of future production leads to prediction of 1500 trillion cu ft ultimate discoveries and with a 15-year life-index asymptote, a 16.4 trillion cu ft/year peak in 1980. Rate forecasts can be explored for 1500–2500 trillion cu ft range and 0, 15-, and 20-year life asymptotes.—*from* Authors' abstract

03878 **Emerson, Alfred E.** A revision of the fossil genus *Ulmeriella* (Isoptera, Hodotermitidae, Hodotermitinae): Am. Mus. Novitates, no. 2332, 22 p., illus., table, 1968.

The fossil genus *Ulmeriella* is redescribed. It is considered to be the most primitive member of the Hodotermitinae and partially bridges the gap between the Termopsinae and Hodotermitinae within the family Hodotermitidae. Phylogenetic, biogeographical, and paleoecological interpretations are included. A brief discussion of the degree of variation and the limits of species among fossil termites is presented. Five species of *Ulmeriella* from temperate Tertiary deposits of Europe, Asia, and North America are included.—*from* Author's summary

Emery, K. O. *See* Uchupi, Elazar. 03780

03675 **Engemann, Joseph G.** Pogonophora—The oldest living animals?: Michigan Acad. Sci., Arts and Letters Papers 1967, v. 53, p. 105–108, 1968.

Interpretation of research on the Pogonophora indicates they include the oldest living animals. Estimates of sediment age at depths reached by the tubes range from 1,000 years to an unlikely 250,000 hears. Various environmental and biological factors bearing on the question are discussed briefly. A slow growth rate is proposed as a reason for, and made possible by, their general abyssal distribution.—Author's summary

Enginun, Mine E. *See* Ingols, Robert S. 03685

03501 **Euwer, Robert M.** Glick field, Kiowa and Comanche Counties, Kansas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1576–1582, illus., 1968.

The Glick field, in Kiowa and Comanche Counties, Kansas, produces from the Mississippian (Osage) "Chert". The gas is trapped stratigraphically. Cumulative production to January 1, 1967, was 180,280 bbl of 60°- gravity condensate and 80.65 billion cu ft of gas.—Author's abstract

Evans, J. R. *See* Geol. Soc. Sacramento. 03755

Ewing, John I. *See* Drake, Charles L. 03643

Ewing, Maurice. *See* Bryant, William R. 03784

03554 **Fabricand, Burton P.; Imbimbo, Eugene S.; Brey, Mary E.** Concentration changes of Ca, Cu, Li, Mg, K, Na, and Sr in the Hudson River, New York: Jour. Sed. Petrology, v. 38, no. 2, p. 671–674, illus., tables, 1968.

Concentrations of Ca, Cu, Li, Mg, K,Na, and Sr at various points in the Hudson River and one of its tributaries during July 1965, have been measured along with conductivity of the water. Ca, Mg, K, Na, and Sr all show a minimum in concentration about 130 km from the mouth, as does the conductivity. The cleanup process necessary to account for this minimum may sharply reduce contribution of dissolved ions to the ocean. Concentration values in ppm averaged over samples taken from three points upstream from the minimum are as follows: Ca, 24.5; Cu, 0.01; Mg, 6.7; K, 1.2; Na, 15.7; Sr, 0.14. There is a large contribution to these elements from ocean waters at least as far as West Point, N. Y., 90 km from the mouth. Upper limits on the concentration of Cr, Co, Fe, Pb, Li, Mn, Ni, and Rb were established.—*from* Authors' abstract

Faure, Gunter. *See* Chaudhuri, Sambhudas. 03906

03590 **Fawcett, J. J.; Ruckldge, J. C.; Gasparrini, E.** Chemistry of some Tertiary basalts from East Greenland [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 572, 1968.

03261 **Faye, G. H.** The optical absorption spectra of iron in six-coordinate sites in chlorite, biotite, phlogopite and vivianite—Some aspects of pleochroism in the sheet silicates: Canadian Mineralogist, v. 9, pt. 3, p. 403–425, illus., tables, 1968.

Electron absorption spectra have been measured in the 7,000–30,000 per cm region. The complex spectra of chlorite and biotite in the visible region show similarities to vivianite, known to contain Fe^{2+} in octahedral sites. It is proposed that most of the features in the 15,000–30,000 per cm region of these spectra are due to spin-forbidden transitions of Fe^{2+}. Spectra of all minerals show a double-band system due to spin-allowed transitions of octahedrally-bonded Fe^{2+}. Splitting of bands is attributed to the dynamic Jahn-Teller mechanism. A relatively intense polarized band at 14,000 per cm, assigned to $Fe^{2+} \rightarrow Fe^{3+}$ interaction, occurs in spectra of chlorite, biotite and some phlogopites. This, together with polarized high-energy charge transfer processes, is the cause of pleochroism in sections of these minerals perpendicular to the (001) cleavage.—*from* Author's abstract

03767 **Faye, G. H.; Nickel, E. H.** The origin of pleochroism in erythrite: Canadian Mineralogist, v. 9, pt. 4, p. 493–504, illus., tables, 1968.

Optical absorption measurements show that pleochroism of erythrite is due to variations in the main absorption envelope in the 400 to 600-μ region as oriented sections are rotated in linearly polarized light. The absorption envelope arises from the $^4T_1(F) \rightarrow {}^4T_1(P)$ transition, with contributions from transitions derived from ^2G and ^2H levels, in octahedrally coordinated Co^{2+} ions, of which there are two kinds (Co_I and Co_{II}) in erythrite. Pleochroism is related to interaction of the electric vector of light with electrons located in specific t_2, orbital lobes of ions in Co_I and Co_{II} sites. Validity of the interpretation rests on assumptions that erythrite is isostructural with vivianite and symplesite and that principal optical directions are essentially coincident with "molecular axes" of the Co^{2+}-bearing octahedra.—*from* Authors' abstract

Fenton, T. E. *See* Ruhe, R. V. 03521

03584 **Ferguson, Carl C.** Mineral resources summary of the Pitcher Ridge quadrangle, Tennessee (including the Tennessee portion of the Hytop quadrangle, Alabama-Tennessee): Nashville, Tenn., Tennessee Div. Geology, 5 p., 1968.

Potential resources in the Pitcher Ridge quadrangle are limestone from the St. Louis, Monteagle, Bangor Limestones and from some of the units of the Pennington Formation; sandstone from the Warren Point Sandstone; clay and shale from the Pennington and Raccoon Mountain Formations; and coal in shale approximately 25 feet below the Warren Point Sandstone in the Raccoon Mountain Formation. The sandstone and coal are probably not of economic significance. This summary accompanies Tennessee Div. Geology Geol. Map GM 87-SE by C. C. Ferguson and R. G. Stearns (cited separately).—MCM

03708 **Ferguson, Carl C.; Stearns, Richard G.** Geologic map of the Pitcher Ridge quadrangle, Tennessee (including the Tennessee portion of the Hytop quadrangle, Alabama-Tennessee): Tennessee Div. Geology Geol. Map GM 87-SE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Pitcher Ridge quadrangle, Tennessee," by C. C. Ferguson is cited separately.—MCM

03253 **Ferm, John C.; Cavaroc, Victor V., Jr.** A nonmarine sedimentary model for the Allegheny rocks of West Virginia, *in* Late Paleozoic and Mesozoic continental sedimentation, northeastern North America—A symposium: Geol. Soc. America Spec. Paper 106, p. 1-19, illus., tables, 1968.

The middle Pennsylvanian Allegheny Formation, which crops out in the Appalachian Plateau of West Virginia, represents nonmarine equivalents of deltaic marine-brackish-nonmarine strata to the northwest. In West Virginia, the Allegheny, 300 feet thick, consists mainly of sandstone, shale, coal, and seatrock units, without much lateral continuity. Sandstone units, presumably fluvial bars, 60 feet thick and roughly 5 miles wide, are arranged *en echelon* within an anastomosing plexus of the other units which suggest backswamp environments. This arrangement of bar sand units probably arises from lateral shifting of channels into lower backswamps. Differences in proportional abundance and dimension of channel and backswamp elements from south to north suggest transition from an alluviated upper deltaic plain to a partially inundated lower deltaic plain.—*from* Authors' abstract

Feulner, Alvin J. *See* Waller, Roger M. 03694

Fields, E. D. *See* Sayers, R. W. 03848

03544 **Fisher, Irving S.** Interrelation of mineralogy and texture within an Ordovician Lexington Limestone section in central Kentucky: Jour. Sed. Petrology, v. 38, no. 3, p. 775-784, illus., 1968.

The 255-ft-thick section reported on here contains only 8 to 9 percent insoluble material. Authigenic quartz is widespread as silt-sized and larger particles. There is little if any subsilt-sized silica in these rocks. Detrital quartz is very sparse except for the basal Curdsville Member. Illite is the only clay mineral group identified. A search for metabentonite proved negative although some admixture is probable. Pyrite is ubiquitous and amounts to units of percent of the insoluble residues. Dolomite is widespread, but minor in the formation. The limestones vary from micrite to coarse biosparite. The environment of deposition ranged from quiet to moderately agitated shallow water.—*from* Author's abstract

03862 **Fisher, John J.** Barrier island formation—Discussion [of paper by J. H. Hoyt, 1967]: Geol. Soc. America Bull., v. 79, no. 10, p. 1421-1426, illus., 1968.

Fisher believes that there is evidence, both surface and subsurface, for a theory of origin for barrier-island shorelines as complex spit chains whether or not a neighboring river system is present. He points out that Hoyt (ibid., v. 78, p. 1125-1136, 1967) does not consider longshore transport anywhere in this theory as an agent of either deposition or erosion. Longshore transport and recent changes in

sea level are the two most important coastal processes along unconsolidated sediment shorelines. Three problems to be solved in the study of barrier-chain shorelines are mentioned.—VSN

03909 **Fleischer, R. L.** Uranium distribution in stone meteorites by the fission track technique: Geochim. et Cosmochim. Acta, v. 32, no. 9, p. 989–998, illus., tables, 1968.

Uranium distributions in a group of stone meteorites have been examined in place on a microscale by the technique of fission track activation, using a thin plastic overlay to detect the tracts. Changes in uranium concentration by factors of 10^5 are observed over distances of 10^{-2} cm. The non-uniformity in uranium content is such that in some samples regions of average uranium content are seldom found, making the usefulness of the term "average" doubtful. The ordinary chondrites of greater major element disequilibrium are found to have increased non-uniformity in uranium content from one chondrule to another and higher values of uranium in the chondrules relative to the matrix material.—Author's abstract

03268 **Flemming, N. C.** Derivation of Pleistocene marine chronology from morphometry of erosion profiles: Jour. Geology, v. 76, no. 3, p. 280–296, illus., 1968.

Former sea levels are recorded by terraces, some submerged and others subaerial; such terraces are not necessarily destroyed by the sea rising or falling past their levels. It is proposed that these terraces can be placed in chronologic order and a sea-level fluctuation curve determined by analysis of erosion profiles alone. "Final" profiles are calculated from assumed "initial" profiles plus a hypothetical sea level–time curve, and are compared to measured profiles to judge the validity of the postulated curve. Although the curve is ambiguous, its ambiguity is reduced by criteria that determine relative age between pairs of terraces.—DRM

03574 **Flores, Romeo M.** Simple linear regression as a means of predicting the thickness of middle Allegheny stratigraphical interval in eastern Ohio: Jour. Sed. Petrology, v. 38, no. 2, p. 400–410, illus., tables, 1968.

A specific solution to prediction of thickness of the Middle Kittanning–Lower Freeport interval from the thickness of enclosed channel sandstone by use of a linear regression model is presented. Application as a predicting equation has increased data of complete stratigraphic sections twofold. Thickness is controlled by thickness of enclosed channel sandstones along the fluviolacustrine and brackish-marine facies. That is, the thicker the sandstones, the thicker the section. Further, the section thickens toward the brackish-marine boundary and thins toward the fluviolacustrine boundary. The data indicate that the linear regression relationship between the two facies does not vary significantly so that a common regression formula was used. This device should be useful in other similar stratigraphic conditions.—HRC

03798 **Flower, Rousseau H.** Cephalopods from the Tiñu Formation, Oaxaca State, Mexico: Jour. Paleontology, v. 42, no. 3, p. 804–810, illus., 1968.

Cephalopods from the middle part of the Tiñu Formation at its type locality include three species of *Rioceras* [two new]. The oldest known occurrence of the genus is in the first endoceroid zone of the El Paso Group, the Cooks Formation [Lower Ordovician, Demingian, = upper Tremadocian?]. This is a widespread zone, extending from the El Paso Group of New Mexico and western Texas into the Manitou of Colorado, the Garden City of northern Utah, the lower Fillmore of western Utah (in the upper part of zone D), and the fauna extends westward into the Goodwin Limestone of Nevada.—Author's abstract

03860 **Foose, Richard M.; Cunningham, Charles G., Jr.** Preglacial Connecticut River course near Amherst, Massachusetts: Geol. Soc. America Bull., v. 79, no. 10, p. 1415–1418, illus., 1968.

Gravity measurements in the Connecticut Valley near Amherst, Mass., delineate a narrow north-south-trending "low gravity" zone, interpreted as a part of the pre-

late-glacial drainage channel of the Connecticut River and its tributaries. These are entrenched in the Triassic Sugarloaf Arkose. Gravity data were derived from a network of 208 stations in an east-west subparallel array covering 42 sq mi between Bull Hill at the north and the Northampton-Amherst road at the south. Reduced Bouguer values were plotted with one-half mgal intervals. Data were correlated with well logs to determine subsurface geological relations. The course of the buried Connecticut River in this area appears to be compatible with suggested pre-late-glacial channel locations to the north and south as determined by seismic investigations.—*from* Authors' abstract

03790 **Ford, J. P.** Upper Ordovician stratigraphic relations between Covington and Clays Ferry, Kentucky: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1779-1784, illus., tables, 1968.

Upper Ordovician rock-stratigraphic units previously described in southwest Ohio and the central Bluegrass area of Kentucky are correlated by comparing lithologic characteristics and clastic percentage curves derived from detailed measured sections in northern Kentucky. The results presented here suggest a southern source area in this region during Late Ordovician time, and a gradual northward shift of concentrated centers of biota.—Author's abstract

03641 **Fox, N. S.; Lohnes, R. A.; Handy, R. L.** Depth studies of Wisconsin loess in southwestern Iowa—[Pt.] 4, Shear strength: Iowa Acad. Sci. Proc. 1966, v. 73, p. 198-205, illus., table, 1968.

The variation of the Couloumb shear strength parameters, c, and ϕ (angle of internal friction) in loess from Harrison County, Iowa, are studied. This is the type section of the Loveland Loess. In general, the hill and road cut consist of approximately 130 feet of post-Farmdale Loess, over 12 feet of Farmdale Loess, over 20 feet of Loveland Loess, over oxidized calcareous Kansan(?) till. The upper 30 feet of loess is not cut and was not included in the description by Daniels *et al* (1959). Below this, the upper 40 feet of the cut has a slope of 50 percent, and the lower 90 feet is cut into three nearly vertical benches.—*from* Authors' abstract

03852 **Fox, Steven K., Jr.** Dipleurozoa from Lower Silurian of North America: Science, v. 162, no. 3849, p. 119-120, illus., 1968.

In a problematical fauna discovered in Australia, 152 m below diagnostic Lower Cambrian species, are fossilized remains belonging in the phylum Coelenterata. These jellyfish-like fossils were defined as a new class (Dipleurozoa) by Harrington and Moore because of their strong bilateral symmetry and differentiated extremities. The class was not reported elsewhere before many specimens were discovered recently in the Shawangunk (Tuscarora) formation at Delaware Water Gap, Pa. Three new species belonging to a new genus can be recognized, the indication being that the class ranges stratigraphically from the infra-Cambrian to at least the Lower Silurian, and geographically from Australia to eastern North America.—Author's abstract

03437 **Freeman, P. S.** Exposed middle Tertiary mud diapirs and related features in South Texas, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 162-182, illus., 1968.

The outcrop area of the Gueydan Formation is characterized by sedimentary volcanic features such as relict mud-volcano vents (silica knobs) along deep-seated faults and fractures; mudflow deposits containing relict vesicles and gasoclasts; erratic igneous blocks and boulders, limestone blocks, and orthoquartzite blocks up to 4,500 cu ft in volume; a diapiric limestone-bearing serpentine mass, and numerous structurally controlled clastic dikes. Natural gas provided the explosive energy to transport this material upward for thousands of feet to the surface upon which Gueydan sediments were deposited. The features are related to regional, deep-seated faults rather than to shallow depositional phenomena.—*from* Author's abstract

03249 **Frei, R. W.; Ryan, D. E.; Stockton, C. A.** The chromatographic properties of transition metal complexes of pyridine-2-aldehyde-2-quinolylhydrazone [with

French and German abs.]: Anal. Chim. Acta, v. 42, no. 1, p. 59–65, illus., tables, 1968.

A scheme has been devised whereby PAQH complexes of iron, nickel, copper and cobalt can be separated chromatographically and determined semiquantitatively in presence of up to tenfold excesses of interfering metal ions. The visual detection limits for iron, nickel and copper were found to be 0.01 μg and for cobalt 0.007 μg per spot. Interesting relationships were observed between R_f values, decomposition temperatures and position of the absorption maxima of the adsorbed complexes.—Authors' abstract

French, Robert R. *See* Rooney, Lawrence F. 03551

03500 **Frensley, Robert W.; Darmstetter, J. C.** Spivey-Grabs field, Kingman and Harper Counties, Kansas. *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1569–1576, illus., 1968.

The Spivey-Grabs field is in southwestern Kingman County and northwestern Harper County, Kansas. The Mississippian "Chert" produces gas and oil, and the Pennsylvanian reservoirs (Burlingame and Topeka Limestones) produce gas. Stratigraphic trapping is important in the Mississippian accumulations, and the Pennsylvanian accumulations are structurally controlled. Cumulative production to January 1, 1967, was 27,686,822 bbl of oil and 168,622,087 Mcf of gas.—Authors' abstract

03882 **Frey, M. Gordon.** Julian W. Low (1904–1968): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1806–1807, portrait, 1968.

03591 **Friedlaender, C. G. I.** Tridymite in mineralized zone at Dunbrack, Musquodoboit River, Nova Scotia [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 572, 1968.

Friedman, Gerald M. *See* Sanders, John E. 03537

Friend, P. F. *See* Allen, J. R. L. 03254

Fuller, M. *See* Kobayashi, Kazuo. 03893

03927 **Funnell, B. M.; Smith, A. Gilbert.** Opening of the Atlantic Ocean: Nature, v. 219, no. 5161, p. 1328–1333, illus., tables, 1968.

A model made of the opening of the Atlantic Ocean shows how the simplest geometric separation of the continents around the Atlantic might account for the gross structure and some hitherto anomalous features of its floor, and might explain the position and sense of wrench faulting in the Alpine orogenic belts around the Mediterranean and Caribbean. A time scale suggested for the opening is consistent with the available paleontological and magnetic survey data. Some predictions regarding the results of the United States Deep Sea Drilling Project have been made.—KAF

03636 **Furnish, W. M.; Spinosa, Claude.** Historic Pennsylvanian ammonoids from Iowa: Iowa Acad. Sci. Proc. 1966, v. 73, p. 253–259, illus., 1968.

The Pennsylvanian goniatite species *Wiedeyoceras sanctijohanis* (Wiedey) was described in 1929 on the basis of two specimens from Greene County, Iowa, collected by O. H. St. John about 1865. An additional lot of specimens representing this species has been secured from a locality only about four miles northwest of the original site. The new material serves to give a better understanding of this fossil and a basis for comparison with comparable specimens from Missouri and elsewhere.—Authors' abstract

Gagliano, S. M. *See* Morgan, James P. 03328

03313 **Galle, O. Karmie.** Routine determination on major constituents in geologic samples by atomic absorption [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 369, 1968.

03629 **Garland, G. D.** Possible rates of relative continental motion [with French abs.], *in* Continental drift, secular motion of the pole, and rotation of the Earth–Internat. Astron. Union, Symposium No. 32, Stresa, Italy, 1967: Dordrecht, Holland, R. Reidel Publishing Co., and New York, Springer–Verlag, p. 19–24, illis., 1968.

Much of the evidence for continental drift, such as the matching of coastlines, provides only an average rate over a very long time interval. Palaeomagnetic results give average velocities between 0.5 and 3.0 cm/yr, with higher values for some areas such as India. These also represent average rates over long times. Very recent research on the magnetic character of the ocean floors suggests that the present rate of ocean floor spreading can be determined. The continents of South America and Africa may be separating at a rate of 4.0 cm/yr.—Author's abstract

Gasparrini, E. *See* Fawcett, J. J. 03590

03524 **Gathright, Thomas M.; Willson, Robert G.** Ground–water fluctuations in Virginia: Virginia Minerals, v. 14, no. 3, p. 17–27, illus., table, 1968.

Significant geologic, topographic, and location data are summarized for each of 19 wells observed in relation to the characteristics and probable causes of water-level fluctuations; basic data are tabulated. Six wells in the Valley and Ridge province are in shale and limestone or dolomite; two in the Blue Ridge province are in slate and metabasalt; seven in the Piedmont are in phyllite, schist, and gneiss; and four in the Coastal Plain are in sand and clay. Factors noted were rapid recharge in fractured bedrock, precipitation effects delayed by thick saprolite, seismic activity, and coastal or earth tides. Yield of wells appears to be related to amplitude of fluctuations; cyclical fluctuations may be masked by local pumping.—GDC

03817 **Gaynanov, A. G.; Kosminskaya, I. P.; Stroyev, P. A.** Geofizicheskiye issledovaniya glubinnogo stroyeniya Beringom morya: Akad. Nauk SSSR Izv. Fizika Zemli 1968, no. 8, p. 3–11, illus., 1968.

Collective interpretation of seismic, gravimetric, and magnetic data yields a picture of the complex mosaic structure of the floor of the Bering Sea. The morphology of the sea bottom reflects the main deep structures. The large crust–mantle blocks have their roots in the mantle and probably extend to depths of several tens of kilometers to 100–200 km. Density contrasts at the boundaries of the blocks range from 0.02 to 0.22 g per cm^3. The western and central blocks are more dense, while the Shirshova ridge, Commander block, Bowers ridge, and Emperor mountains are less dense.—DBV

Gemperle, M. *See* Dehlinger, P. 03627

03755 **Geol. Soc. Sacramento; Evans, J. R.; Matthews, R. A.** (editors). Geologic studies in the Lake Tahoe area, California and Nevada—Ann. Field Trip Guidebook, 1968: Sacramento, Calif., Geol. Soc. Sacramento, 99 p., illus., tables, geol. map, 1968.

This guidebook contains seven papers (cited separately) of general nature dealing with the geology of the Lake Tahoe region, and logs for a field trip. The field trip is for two days, making 10 stops, each of which is described briefly. No log for the actual mileage and route is included, however.—HRC

03689 **Gerstenhauer, A.** Diskussionsbemerkungen zu "Physiographic and geologic control in development of Cuban mogotes" von V. Panoš and O. Štelcl [1968]: Zeitschr. Geomorphologie, new ser., v. 12, no. 2, p. 165–168, 1968.

Gerstenhauer indicates that Panoš and Štelcl have oversimplified the problem of this type of karst topography. It is pointed out that such karst is neither typical of nor widespread in the tropics. In the development of these forms the climatic factor predominates but other geologic and biologic factors should not be ignored. Factors such as variations in rock resistance and effect of salinity of water on landforms are discussed.—JWC

03857 **Gibson, Thomas G.** Stratigraphy and paleoenvironment of the phosphatic Miocene strata of North Carolina—Reply [to discussion by W. P. Leutze, 1968]: Geol. Soc. America Bull., v. 79, no. 10, p. 1437–1447, 1968.

In reply to Leutze's criticisms (ibid., p. 1433–1436), a brief review is given of concepts and data that permitted Gibson's original interpretations (ibid., v. 78, p. 2321–2328, 1967). It is demonstrated that, contrary to Leutze's beliefs, a large number of studies have shown that (1) there is a well-documented series of foraminiferal depth zones on the continental shelf; (2) the depth zones are best defined in terms of relative abundances of species; and (3) the depth zones can be applied to the fossil record. The concepts used are not restricted to foraminiferal studies.—*from* Author's introduction

03592 **Giese, Rossman F., Jr.** A refinement of the crystal structure of borax $Na_2B_4O_5(OH)_4 \cdot 8H_2O$ [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 573, 1968.

03593 **Gillott, J. E.** The scanning electron microscope in fabric investigations [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 573, 1968.

03460 **Gilreath, J. A.** Electric-log characteristics of diapiric shale, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 137–144, illus., 1968.

Diapiric shale along the Texas and Louisiana coast is highly pressured and characteristically has low values of resistivity, density, and acoustic velocity. Deep water marine shale in normal stratigraphic position may have the same properties also, so that dipmeter readings may be necessary to distinguish the two. In the diapir, the dips are away from the apex of the structure when approaching it from above, just as with salt domes, but once in the low resistivity area, the dips remain constant in magnitude and azimuth and approximate the contact between the diapiric shale and normally bedded strata. In shale surrounding salt domes, the dips within the shale are random.—HRC

Glenister, Brian F. *See* Mikesh, David L. 03632

Glover, P. *See* Kovach, R. L. 03915

Goebel, Edwin D. *See* Merriam, Daniel F. 03471

03775 **Goebel, Edwin D.** Mississippian rocks of western Kansas: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1732–1778, illus., table, 1968.

In western Kansas, Mississippian rocks are all marine (except for some Chesteran rocks) and all in the subsurface. Unconformities set off dominantly carbonate Mississippian rocks from Pennsylvanian rocks above and Cambrian to Devonian rocks below. Diagenetic alterations, facies changes, and karst complicated the establishment of lateral stratigraphic equivalents. Dolomitization, silicification of fossils, and chertification are widespread. Conodont faunas are correlated with conodont biostratigraphic zones of the type area of Mississippian rocks. The primary sediment source of Osagian and Meramecian rocks was biogenetic. An increased content of clastic (quartz) rocks in upper Meramecian strata marks an important change in sediment source. In Chesteran rocks, sandstone, siltstone, and thin limestone beds predominate.—*from* Author's abstract

03688 **Goldman, Charles R.; Court, James.** Limnological studies of Lake Tahoe, *in* Geologic studies of the Lake Tahoe area–Geol. Soc. Sacramento, Ann. Field Trip Guidebook, 1968: Sacramento, Calif., Geol. Soc. Sacramento, p. 60–66, illus., 1968.

The water-containing basin of Lake Tahoe is characterized by steep sides and a broad flat bottom. A block diagram, produced from earlier soundings, is included. The deepest part is 1,600 feet, and more than half of the total area is deeper than 1,400 feet. The steepest portion is near Rubicon Point where the slope angle is more than 40°. Numerous projections occur above the otherwise flat floor of the lake; the largest is a "lake mount" of uncertain composition, though it is probably a volcanic feature of some sort. The basin offers a closed depositional system for

clays, etc., and factors affecting clay mineralogy and diagenesis, such as source rocks, drainage patterns, climates, and physical and chemical conditions of depositon have remained relatively constant for a long while.—HRC

03289 **Golightly, D. W.; Mossotti, V. G.** Atomic-absorption characteristics of a premixed nitrous oxide-acetylene flame from a total-consumption burner [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 631, 1968.

03853 **Gomberg, David N.; Banks, Philip O.; McBirney, Alexander.** Guatemala—Preliminary zircon ages from Central Cordillera: Science, v. 162, no. 3849, p. 121-122, illus., table, 1968.

Concordia resolution of uranium-lead analyses of zircons from rocks of the Guatemalan Cordillera indicates a period of plutonism, and perhaps metamorphism, in late Paleozoic times (345±20 m.y.). Gneisses of the Chuacus Series yield an age of 1075±25 m.y., which may be either the age of a source terrain for the original sediments or the age of principal metamorphism. Zircons from a Paleozoic granite intruding the gneisses appear to contain inherited or contaminating material acquired during the process of magma generation or emplacement, or both.—Authors' abstract

Gordon, W. A. *See* Barnes, R. M. 03301

03305 **Gordon, W. A.** Analysis of microgram samples using a controlled arc in argon applied to a common-matrix method [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 367, 1968.

Gorrell, James. *See* Dooley, John A. 03319

03935 **Gottfried, David; Greenland, L. Paul; Campbell, E. Y.** Variation of Nb-Ta, Zr-Hf, Th-U, and K-Cs in two diabase-granophyre suites: Geochim. et Cosmochim. Acta, v. 32, no. 9, p. 925-947, illus., tables, 1968.

Concentrations of Nb, Ta, Zr, Hf, Th, U and Cs have been determined in samples of the diabase-granophyre suites from Dillsburg, Pa., and Great Lake, Tasmania. Average Nb:Ta ratios are 13.5 for the Great Lake and 14.4 for the Dillsburg suites. The Zr:Hf ratios decrease from 68 to 33 with progressive differentiation. Average Th:U ratios are 4.1 for the Dillsburg and 4.4 for the Great Lake suites. A comparison of the abundance of these elements is made with those of oceanic tholeiites from the Atlantic and Pacific. Trace elements with large ionic radii (Th,U,Cs) are present in significantly greater concentrations in the two continental tholeiitic series; this is not true for lithophilic elements of smaller ionic radii (Zr, Nb). These patterns indicate: (1) crustal contamination does not entirely account for differences between continental and oceanic tholeiites, and (2) the oceanic tholeiites do not necessarily delimit the geochemical characteristics of the mantle.—*from* Authors' abstract

03438 **Gould, Don B.; deMille, George.** Piercement structures in Canadian Arctic islands, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 183-214, illus., 1968.

The Sverdrup basin contains many piercement structures with exposed cores of gypsum and anhydrite. Salt is not known but is suggested by gravity data. In the west, the structures are large domal features which show little or no tangential compression; they are probably salt domes which resulted from halokinesis, or geostatic loading. In the east, some piercement structures are large and domal, but most are small and elongate and are associated with major faults. These appear to have resulted from diapirism initiated by tangential forces during the Laramide orogeny.—*from* Authors' abstract

03779 **Grafton, Dean.** James Richard Schwabenland (1926-1968): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 7, p. 1306-1307, portrait, 1968.

03548 **Gram, Ralph.** A Florida *Sabellariidae* reef and its effect on sediment distribution: Jour. Sed. Petrology, v. 38, no. 3, p. 863-868, illus., tables, 1968.

Heavy minerals and size distribution of bottom sediments and reef materials have been examined in a *Sabellariidae* reef at Seminole Shores, Florida, approximately 100 miles northeast of Miami. Heavy mineral and shell fragment percentages in the reef material are up to ten times greater than in the adjacent bottom sediments. This distribution results from the tendency of the worm *Phragmatopoma lapidosa* to utilize the finer mineral grain sizes and platy shell fragments in tube construction. Accordingly, these worms improve the sorting of the beach sediments to a significant degree.—Author's abstract

03662 **Grantham, Rodney G.; Sherwood, C. B.** Chemical quality of waters of Broward County, Florida: Florida Div. Geology Rept. Inv. 51, 52 p., illus., tables, 1968.

Water of good chemical quality in Broward County is obtained from the highly productive Biscayne aquifer, which is part of an interconnected ground and surface water system. The water is calcium bicarbonate in type and ranges from hard to very hard and neutral to slightly alkaline. Iron in the southern part of the county, and chloride near the coast and in the lower part of the Biscayne aquifer in inland areas are objectionable constituents. Large quantities of water are available in the artesian Floridan aquifer at depths below 900 feet, but the water is salty. This aquifer is used for the disposal of sewage effluent at one location. Surface water is generally good but varies in chemical quality with the seasons, surface runoff diluting the mineral content of the canals during the rainy season.—MST

Greenland, L. Paul. *See* Gottfried, David. 03935

03801 **Gregson, Victor G., Jr.** Computation of surface wave dispersion in a free plate using ray theory [abs.]: Earthquake Notes, v. 39, nos. 1–2, p. 14, 1968.

03806 **Greiner, Hugo.** Silurian–Devonian relationships, Charlo map-area, New Brunswick, *in* Internat. Symposium on the Devonian System, Calgary, Alberta, 1967 [Proc.], V. 2: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 973–979, illus., 1967 [1968].

Geological field work in the Charlo area on Chaleur Bay, New Brunswick, has revealed some 14 mappable units of sedimentary and extrusive and intrusive igneous rocks. The rhyolitic Benjamin Formation succeeds the New Mills Redbeds; these in turn lie unconformably upon fossiliferous beds of the Nash Creek Formation, which is in part Wenlock in age. The oldest Devonian formation, the Louison Creek mudstone and limestone unit, contains a New Scotland (earliest Devonian) fauna in abundance and, since it is followed by palagonite tuff-bearing extrusives as in the type Dalhousie, it is correlated with Zone *0* of that section. Although no actual Silurian–Devonian contact is exposed, it appears that vulcanism in the Late Silurian was succeeded by Early Devonian stable-shelf carbonates; quite likely a hiatus and disconformity lie between.—Author's abstract

03847 **Grosvenor, N. E.** Increasing interest shown in rock mechanics: Mining Eng., v. 20, no. 2, p. 85–87, illus., 1968.

Rock mechanics studies showed a wide variety of applications in 1967. Eleven articles from the literature are reviewed that describe applications of various techniques to problems in surface and underground mining.—MAC

03280 **Grunder, F. I.; Boettner, E. A.** Some experimental considerations in atomic absorption [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 360, 1968.

03799 **Gryc, George; Dutro, J. T., Jr.; Brosgé, W. P.; Tailleur, I. L.; Churkin, Michael, Jr.** Devonian of Alaska, *in* Internat. Symposium on the Devonian System, Calgary, 1967 [Proc.], V. 1: Calgary, Alberta, Alberta Soc. Petroleum Geologists, p. 703–716, illus., 1967 [1968].

Deposition was controlled by two positive and two negative tectonic elements. Lower Devonian rocks are scarce except in the east-central part, and perhaps southeastern. Carbonate rocks of Middle Devonian age have the widest distribution, blanketing the northern half of the State; they reflect deposition on a shallow shelf along the margin of a geosyncline, with thicknesses ranging from a few hundred

to a thousand feet. In southeastern Alaska a section up to 5,000 feet includes clastics. The Upper Devonian is dominated by clastic rocks, except in the northwest, and is the thickest, more than 12,000 feet in the Brooks Range. Paleogeography and biostratigraphy are reviewed. Sketch maps show distribution of the Devonian, and tectonics; a structure section through the eastern Brooks Range, and a correlation chart are included.—ESL

03315 **Guinn, Vincent P.** Current status and recent progress in the field of activation analysis [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 369, 1968.

Guinot, B. *See* Markowitz, William. 03628

03463 **Gussow, William Carruthers.** Salt diapirism—Importance of temperature, and energy source of emplacement, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 16–52, illus., table, 1968.

Heat is critical for the occurrence of salt intrusion. It becomes soft and plastic and flows indefinitely at 400° F. When buried at a depth of more than 25,000 feet, sedimentary salt becomes mobile and behaves hydrodynamically; it moves laterally to places of lower overburden pressure, where doming and piercement occur. Emplacement of igneous masses, such as plugs, batholiths, etc., and other types of diapirs is similar to that of salt piercements. In all cases, the prime motivating force is weight differential of overburden. The author postulates that salt-dome intrusion is thermally activated and the rate of salt intrusion is rapid, catastrophic on the geologic time scale; growth is a measure of rate of compaction of adjacent sediments.—*from* Author's abstract

03823 **Hadsell, F. A.** History of earthquake activity in Colorado, *in* Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well, Pt. A: Colorado School Mines Quart., v. 63, no. 1, p. 57–72, illus., tables, 1968.

A qualitative evaluation in terms of intensity based on felt reports recorded in the press is presented for the period 1870 to 1967. After 1962 short period instruments of high magnification were available for quantitative evaluation. This report concludes that: 1. The majority of earthquake activity in Colorado occurs west of the mountain front. 2. No earthquake with intensity greater than VII on the Modified Mercalli Scale has occurred in Colorado in the past 100 years. 3. The VII intensity earthquake of November 7, 1882, could have been similar in magnitude and location to the August 9, 1967, quake discussed in the preceding report. This would be consistent with the idea that significant strain energy is stored near Denver and while its release can conceivably be triggered by fluid injection in the Arsenal well, it can also occur spontaneously.—Author's abstract

03298 **Hakkila, E. A.; Hurley, R. G.; Waterbury, G. R.** X-ray fluorescence spectrometric determination of rare earths in plutonium [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 364, 1968.

03782 **Halbouty, Michel T.** Giant oil and gas fields in United States: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 7, p. 1115–1151, illus., tables, 1968.

Giant oil and gas fields provided 50.7 percent of the U.S. production in 1966, and were estimated to contain about 57 percent of the nation's crude reserves. The rate of discovery of new giant fields is declining. A greater emphasis should be placed on the search for subtle traps with large accumulations.—WCC

Hall, G. F. *See* Ruhe, R. V. 03521

03693 **Hamilton, L. J.; Paulson, Q. F.** Geology and ground-water resources of the lower Bighorn Valley, Montana: U.S. Geol. Survey Water-Supply Paper 1876, 39 p., illus., tables, 1968.

The Bighorn River has incised a deep, broad valley in Cretaceous strata below the mouth of Bighorn Canyon; it ceased downcutting at six different levels, widening its flood plain and alluviating each level with about 30 feet of sandy gravel that

forms the only economic source of ground water in large areas where bedrock consists of relatively impermeable shale to great depths. Ground water in the alluvium is hard and in irrigated lowlands is highly mineralized locally. Three bedrock sandstone aquifers, present at moderate depths, yield soft, moderately to highly mineralized water with a high percent of sodium. Alluvial gravel deposits, mantled by thick alluvial and colluvial deposits, drain slowly and confine ground water under artesian pressure locally in irrigated central and southern lowlands. [Suggestions are made for controlling discharge of irrigated land.]—*from* Authors' abstract

03903 **Hamilton, N.; Owens, W. H.; Rees, A. I.** Laboratory experiments on the production of grain orientation in shearing sand: Jour. Geology, v. 76, no. 4, p. 465–472, illus., table, 1968.

Five experiments are described in which a bed of sand was subjected to shear and the resulting grain orientation estimated from measurements of anisotropy of magnetic susceptibility. Two experiments involved dry sand on angle-of-repose slopes, two involved the immersion of the inclined bed in still water,and in one the bed formed the foresets of a delta produced in a horizontal flume. The longest and shortest axes of the sand grains were always preferentially aligned in the plane perpendicular to the strike, longest axes being at a small (25°–37°) angle to the surface of accumulation. High magnetic q-values were characteristic of all the deposits. The results are consistent with the prediction of alignment of longest axes approximately in the direction of motion and shortest axes in the direction of maximum velocity gradient.—*from* Authors' abstract

03829 **Hamilton, Wayne L.** A change in the size-distribution of dust falling in the Polar regions over the past fourteen centuries: Polarforschung 1966, v. 36, no. 6, pts. 1–2, p. 107–112, illus., 1968.

The size-distribution of particulate fallout of 0.6 to 3 microns diameter has been measured in samples of ice and snow from Greenland and Antarctica. The shape of the average size-distribution curve exhibits a pronounced change with time. In older samples the cumulative frequency is usually convex upward; in younger, there is a progressive tendency toward straight or convex downward distribution. Most of the change seems due to particle population smaller than 1.5 microns. Microscope investigations in recent samples indicate that the new population, changing less rapidly in Greenland than in Antarctica, may be associated with increased abundance of black particles with metallic luster. Possibly the smaller size fraction slowly dissolves in ice and is consequently less abundant in older samples. Evidence does not rule out the possibility that the greater relative abundance of submicron particles is related to increased man-caused air pollution.—GDC

03734 **Hamming, Edward.** On laterites and latosols: Prof. Geographer, v. 20, no. 4, p. 238–241, 1968.

Through quoted definitions it is shown that there is not only inconsistency but serious discrepancy in the use of the terms "laterite" and "latosol." The suggestion is made that as far as nomenclature of tropical soils is concerned it might be wise to drop these terms for, by use of the terminology of the new soils classification of the Soil Survey Staff of the U.S. Department of Agriculture, differentiation can be made between oxisols and ochrosols.—LLR

03267 **Handy, R. L.; Lohnes, R. A.** Sodium chloride content and compaction in deep-sea cores—A discussion [of paper by P. J. Wangersky, 1967]: Jour. Geology, v. 76, no. 3, p. 365–368, illus., 1968.

Wangersky's conclusion [ibid., v. 75, p. 332–335] that the sodium chloride content of deep-sea sediments is a result of natural consolidation processes is assessed as correct. Wangersky's correlation of log percent of NaCl versus depth, however, can be improved by use of Terzaghi's theory of consolidation of soils, in which percent of NaCl is a function of the logarithm of the depth.—*from* Authors' conclusions

Handy, R. L. *See* Lohnes, R. A. 03271

Handy, R. L. *See* Senich, Donald. 03630

Handy, R. L. *See* Fox, N. S. 03641

Handy, Richard L. *See* Tinoco, Fernando H. 03634

Hanley, John M. *See* Beebe, B. W. 03326

03698 **Hansen, Arnold J., Jr.** Availability of ground water in the Oakton quadrangle and part of the Wolf Island quadrangle in Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-182, scale 1:24,000, text, 1968.

Ground water is abundant for domestic, irrigation, and industrial use in the Oakton quadrangle and the Kentucky part of the Wolf Island quadrangle. Principal aquifers are Eocene sands which underlie the entire area and Pleistocene alluvial gravel. Water in the Quaternary alluvium is very hard and generally contains 425–525 ppm of dissolved solids, pH is between 7.2 and 7.9, and iron and manganese contents are exceedingly high. Quality of water in the Eocene strata is satisfactory for most uses. A table lists iron content and hydrogen-ion concentration.—MCM

03700 **Hansen, Arnold J., Jr.** Availability of ground water in parts of the Cairo and Barlow quadrangles in the Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-186, scale 1:24,000, text, 1968.

Ground water for domestic, irrigation, and industrial use is abundant in parts of the Cairo and Barlow quadrangles in Kentucky. Principal aquifers are Pleistocene alluvial gravel, Pliocene(?) and Pleistocene gravel, and Eocene sand. Although the quantity of water available in most aquifers is adequate for domestic and larger supplies, the quality is not always satisfactory without treatment. Water in the Pleistocene alluvium contains excessive iron, is locally hard, and contains about 475 ppm dissolved solids; that in the lower gravel is hard and contains about 150–300 ppm dissolved solids; and that in Eocene strata is generally soft with about 75–150 ppm dissolved solids. A table lists iron content and hydrogen-ion concentration.—MCM

03766 **Harder, A. H.; Sauer, V. B.; Broussard, W. L.** Water resources of the Lettsworth–Innis–Batchelor area, Pointe Coupee Parish, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph. 21, 28 p., tables, 1968.

Large quantities of good quality water are available to residents of Lettsworth, Innis, and Batchelor, and in nearby areas of Pointe Coupee Parish from the Mississippi and Raccourci Old Rivers. The quality of both rivers is similar, dissolved-solids concentrations ranging from about 110 to 400 ppm, hardness from 70 to 200 ppm, sediment from 50 to 3,500 ppm, and pH from 6.7 to 8.2. Underlying sands 20 to 100 feet thick yield large quantities of fresh ground water. Quality of ground water generally improves with depth. Wells less than 400 feet deep usually yield $CaCO_3$ type water that is hard and high in iron. Deeper wells (400 to 1,200 feet) yield softer, Na_2CO_3 water having a hardness of 4 to 80 ppm, less Fe (0.00 to 1.4 ppm), and a pH of 7.0 to 8.8.—MST

Harris, D. C. *See* Keys, J. D. 03760

03820 **Harris, D. C.; Jambor, J. L.; Lachance, G. R.; Thorpe, R. I.** Tintinaite, the antimony analogue of kobellite: Canadian Mineralogist, v. 9, pt. 3, p. 371–382, illus., tables, 1968.

Re-examination of kobellite from Hvena, Sweden, and three new North American localities [Rossland area, British Columbia; Tintina silver mines, Yukon; Raleigh area, N. C.] led to its redefinition and discovery of the antimony analog. Electron probe analyses show a solid solution series extending from the high bismuth member to the antimony end-member. Ideal formula for the series is $5PbS{\cdot}4(X)_2S_3$ where X is Bi and/or Sb. The structural cell is orthorhombic with space group Pnnm. Unit-cell dimensions for kobellite with 70 percent Bi are a = 22.62, b = 34.08, c = 4.02

A, while those of the pure antimony member from Tintina are a=22.30, b=34.00, c=4.04 A. It is proposed that the name kobellite be retained for minerals having Bi:Sb>1:1, and that antimony-rich members, Bi:Sb<1:1, be assigned the new name tintinaite.—*from* Authors' abstract

03789. **Harris, John F.** Carbonate rock characteristics and effect on oil accumulation in Mid-Continent area: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1662–1669, illus., 1968.

Detailed sample studies are necessary to evaluate the porosity and permeability characteristics of carbonate reservoirs. Depositional porosity fabrics and the resultant permeability are varied, and may range from highly porous impermeable chalk to less porous but more permeable intergranular porosity in carbonate banks, which may be composed of pellets, oolites, or admixtures of fragmental debris. Tectonism can alter the basic porosity–permeability relations by means of fracturing, recrystallization, and/or tectonic dolomitization. These varied porosity fabrics can be recognized by sample and core examination; a method of qualitative and quanitative logging is suggested.—*from* Author's abstract

03473 **Hartman, F. H.** Jerusalem gas field, Conway County, Arkansas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1682–1692, illus., tables, 1968.

Dry gas comes from two sands in the lower part of the Atoka Series; the upper is the "Allen" and the lower is the "Barton", or "Barton B". A third sand, the McGuire, overlies the Allen and may be productive on high structures. The gas is trapped in a faulted anticline with a water barrier on the downdip sides of the fault. The Barton is limited by porosity changes, a normal fault, and by water. Three Ordovician formations are potential reservoirs: the St. Peter Sandstone, the Cotter Dolomite, and the Powell Dolomite. Eighteen to 25 billion cu ft of gas are estimated in reserve.—*from* Author's abstract

03523 **Harvy, Ralph.** The West Campbell field—Key to unlock the Hunton: Shale Shaker, v. 18, no. 9, p. 183–195, illus., 1968.

The West Campbell gas field, in northwestern Oklahoma, exhibits many facets which might prove the depositional sequence proposed in this study of the Silurian Devonian Hunton Group in the Anadarko Basin. The producing upper dolomite facies, a scalloped shoreline band varied by fluctuations of the sea, draped itself around noses of the underlying Sylvan Shale reflecting a series of ridges and valleys perpendicular to the depositional axis. By themselves the dolomite pods, breeched by shore streams and long-shore currents, give locally misleading indication of the deeper Aledo trend. Overlay of structure contour maps of the two surfaces aids in more accurate estimation of thicknesses. Economically, six shallow test wells are more prudent than one in the deeper trend.—GDC

03731 **Hatfield, Craig Bond.** Stratigraphy and paleoecology of the Saluda Formation (Cincinnatian) in Indiana, Ohio, and Kentucky: Geol. Soc. America Spec. Paper 95, 34 p., illus., table, 1968.

This Ordovician unit, across the Indiana–Kentucky boundary, is lens-shaped, essentially calcitic dolomite thinly interbedded with fossiliferous limestone and shale. A laterally persistent clay shale in the lower half is an isochronous marker; a zone of corals lies near the base, a coral–stromatoporoid zone near the top. Quiet, shallow lagoonal deposition is suggested, random orientation of coral colonies denoting outer turbulence. Centripetal decrease in calcite–dolomite ratio reflects greater salinity during middle Saluda deposition; dolomite apparently was a primary precipitate, or formed early by recrystallization of magnesian calcite or by reaction of mud with penesaline water. There are scattered signs of intermittent subaerial exposure by evaporation; normalcy returned by subsidence greater than that with which coral growth could keep pace.—GDC

Hatten, C. W. *See* Meyerhoff, A. A. 03441

03482 **Haun, John D.; Lucas, George B.** Origin and accumulation of natural gas, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1990–1994, illus., 1968.

This paper is intended to introduce the student or nongeologist to some of the concepts of the origin and accumulation of natural gas. Natural gases consist of methane, carbon dioxide, and nitrogen, and small quantities of hydrogen sulfide, heavier hydrocarbons, helium, and very rarely, hydrogen. Major gases result from bacterial action on organic and inorganic matter within sedimentary rocks. Thermal processes may account for some in special cases. Helium is unique in that it is the product of radioactive decay of uranium and thorium. Migration occurs in solution in the ground water and by migration through fluids in porous rocks, and entrapment results when the rising gas meets an impenetrable barrier.—*from* Authors' abstract

03825 **Haun, John D.** Structural geology of the Denver basin—Regional setting of the Denver earthquakes, *in* Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well, Pt. A: Colorado School Mines Quart., v. 63, no. 1, p. 101–112, illus., 1968.

Structural contour maps on the Dakota Group and on Precambrian basement, indicate a northeasterly orientation of basement faults and folds in the region north of the Rocky Mountain Arsenal disposal well. The structurally lowest point in the basin, at Dakota depth, is at least 15 miles west of the Arsenal well and, at Precambrian depth, more than 30 miles south of the well. The strike of the Precambrian–Paleozoic contact at the well is N. 45° W., and the dip is 35 feet per mile southwest. Prominent northwest-trending en echelon faults and folds extend east of the mountain front for two or three miles. The dominant structural trend north of the well is northeasterly. The strong east-west trend of aeromagnetic contours probably indicates that the strike of metamorphic basement rocks in the central Denver Basin is also east-west.—*from* Author's abstract

Havens, Raymond G. *See* Myers, Alfred T. 03308

03297 **Hayden, John A.** Determination of K, Rb, and Cs in Pu-alkali metal compounds by a combined ion-exchange and X-ray fluorescent technique [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 363, 1968.

Hayes, Dennis E. *See* Pitman, Walter C., 3d. 03944

Hébert, Paul. *See* Perrault, Guy. 03603

03865 **Hedberg, Hollis D.** Significance of high-wax oils with respect to genesis of petroleum: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 736–750, table, 1968.

High wax content of crude oil appears to be an original characteristic related to genetic environment or to kind of organic matter from which the oil was derived. A review of worldwide distribution of probable high-wax crudes indicates that they are restricted largely to certain stratigraphic sequences and regions. These sequences have in common the following: shale-sandstone (as opposed to carbonate) lithology; nonmarine origin or origin in waters of less-than-normal-marine salinity; common association with coal or other highly carbonaceous strata; stratigraphic range from Devonian to Pliocene, inclusive; continental, paralic, or nearshore-marine environment; association with low-sulfur (rather than high-sulfur) crudes. High-wax oils may reflect the contribution of terrigenous organic matter (or of organic matter derived from aquatic organisms associated with waters of less-than-normal-marine salinity).—*from* Author's abstract

03747 **Hedlund, R. W.; Norris, G.** Spores and pollen grains from Fredericksburgian (Albian) strata, Marshall County, Oklahoma: Pollen et Spores, v. 10, no. 1, p. 129–159, illus., 1968.

The Antlers Sand and "Walnut" clay underlying the Goodland Limestone have been examined from three localities in Marshall County, Okla., for palynomorphs. Eighty

species (5 new species and 2 new genera) have been recovered from 12 samples. Fossil microplankton are also present but are not described in this study. Comparisons of the "Walnut"-Antlers spore-pollen assemblages with those from elsewhere in North America suggest an Albian age. Presence of dicotyledonous pollen, including tetra- and pentacolpate and tetra- and pentachotomosulcate types in these pre-Upper Cretaceous strata is noteworthy. No other total spore-pollen assemblages have been illustrated in the literature from Lower Cretaceous rocks of southern midcontinental U.S.—*from* Authors' summary

Heidel, Sumner G. *See* Boggess, Durward H. 03653

03756 **Hem, John D.** Aluminum species in water, [Chap.] 4 *in* Trace inorganics in water—Am. Chem. Soc., 153d Ann. Mtg., Miami Beach, Fla., 1967, Div. Water, Air and Waste Chemistry Symposium: Washington, D.C., Am. Chem. Soc. (Adv. Chemistry Ser. 73), p. 98–114, illus., table, 1968.

Polymeric species of aluminum and hydroxide formed in 0.01*M* $NaClO_4$ solutions $10^{-3.34}M$ in aluminum after adding sufficient OH to reach pH 4.75–6.50 were identified by electron microscopy as gibbsite. The particles had diameters near 0.10μ after 10 days of aging, when r, the molar ratio of bound OH/total Al, was between 2.0 and 3.0. When r exceeded 3 the precipitate formed was bayerite. Standard free energy values determined, in kcal per mole, include: $AlOH^{2+}$, -165.2; $Al(OH)_4^-$, -311.7; $Al(OH)_3$ (monocrystalline gibbsite), -272.3; $Al(OH)_3$ (bayerite), -274.0. Many natural waters contain enough fluoride that predominant aluminum solutes are fluoride complexes.—*from* Author's abstract

Henneman, A. B. *See* Jodry, R. L. 03256

03294 **Herglotz, H. K.** Use of total reflection at the critical angle for dispersion of ultrasoft X-rays [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 363, 1968.

03621 **Heron, S. Duncan, Jr.** Low power magnification photography of thin sections: Jour. Sed. Petrology, v. 38, no. 3, p. 945–948, illus., 1968.

Thin sections of any type of rock can be photographed at very low magnifications (1 to 3 times) using a 35 mm single lens reflex camera, bellows extension, slide copying attachment, and various filters. Transmitted plain, polarized, or infrared radiation may be used. The infrared radiation is most useful for studying bioturbate textures, especially when traces of organic matter are still retained in the rock. Examples of bioturbate structures from the Oligocene Cooper Marl are given. Author's abstract

03943 **Hess, H. H.** Reply [to "Arthur Holmes—Originator of spreading ocean floor hypothesis" by A. A. Meyerhoff (1968)]: Jour. Geophys. Research, v. 73, no. 20, p. 6569, 1968.

The idea of sea-floor spreading was derived by Hess largely from new geophysical and topographic data on mid-ocean ridges, none of which was available to Holmes. The concept of relating spreading to magnetic reversals (Vine and Mathews, 1963) could not have been conceived starting from Holmes' model (a thick, basaltic crust of the order of 100 km stretched and thinned by underlying convection). The term "sea-floor spreading," which nicely sums up Hess' concept, was coined by Dietz (1961).—DBV

Hicks, W. G. *See* Musgrave, A. W. 03442

03290 **Hieftje, G. M.; Malmstadt, H. V.** Use of a controlled stream of uniform-sized droplets to study atomization in flame spectrophometry [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 361, 1968.

High, Lee R., Jr. *See* Picard, M. Dane. 03533

High, Lee R., Jr. *See* Picard, M. Dane. 03572

03516 **Hills, John M.** Gas in Delaware and Val Verde basins, West Texas and southeastern New Mexico, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1394–1432, illus., tables, 1968.

Fifty-four thousand cu mi of potentially gas-bearing Paleozoic rocks are present and 98 gas fields are known. The Cambro-Ordovician Ellenburger Limestone is a big producer, and Silurian and Devonian carbonate rocks also contain much gas; all the series of the Pennsylvanian produce gas somewhere in the basins, as do the coarse clastics of the Lower Permian. Brief summaries of some of the fields are given. There are two classes of potential prospects, deep structural traps and stratigraphic sandstone traps along the northwest and east sides of the Delaware basin.—HRC

03517 **Hinds, Norman E. A.** Geology and road log of Pinnacles National Monument: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 8, p. 119–121, illus., reprinted 1968; originally published 1952.

This material, reprinted from *Evolution of the California landscape*, California Div. Mines and Geology Bull. 158 (out of print), gives a brief summary of the geomorphic features, volcanic episodes, faulting, and erosion that contributed to the bizarre landscape of this area in the Gabilan Mountains south of Hollister. The road log is taken (in altered form) from *Guidebook to the Gabilan Range and adjacent San Andreas fault*, published by the American Association of Petroleum Geologists, Pacific Section, 1967. The illustrative geologic map and information on which both parts of this paper was based are from the work of Philip Andrews (1936).—GDC

03656 **Hinman, Eugene E.** A biohermal facies in the Silurian of eastern Iowa: Iowa Geol. Survey Rept. Inv. 6, 52 p., illus., table, 1968.

Four bioherms from the Gower Dolomite, Niagaran Series of the Silurian of eastern Iowa, were chosen for detailed study as typical of Iowa bioherms. These typically oval mounds consist of two parts: a central unstratified core, and peripheral, well stratified flank beds which abut against the core on one side and dip radially away from it on the other. Core and flanks are petrographically nearly identical but structurally and paleontologically dissimilar. The core is the more fossiliferous, coelenterates predominating with pelmatozoans and brachiopods secondary. Core and flanks are both porous, the result of solution activity and fracturing. The general lack of coarse debris indicates that the bioherms developed under more quiet energy conditions than those in Illinois. The Iowa structures were probably formed in a shallow, lagoonal environment near the western shore of the Niagaran sea.—MST

Hirst, D. M. *See* Kaye, M. J. 03556

03483 **Hitchon, Brian.** Geochemistry of natural gas in western Canada, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1995–2025, illus., tables, 1968.

Study of modern and ancient marine environments and the origin and geochemistry of the components in natural gases leads to the conclusion that the two main factors which determine regional variations of the composition of natural gases (and crude oils) are the environment of deposition of the sediments and subsequent maturation effects. Isopach-facies-gas occurrence maps, geologic cross-sections, and natural-gas analytical data for most major stratigraphic units in the Western Canada sedimentary basin are included, and study of these data confirms the hypothesis that natural-gas composition and occurrence are controlled by facies and maturation.—Author's abstract

03907 **Hobbs, B. H.; Talbot, J. L.** The analysis of strain in deformed rocks—Reply [to discussion by W. M. Chapple, 1968]: Jour. Geology, v. 76, no. 4, p. 494, 1968.

The authors emphasize again that homogeneity of strain in bedded rocks cannot be assumed, as Chapple is obliged to do in his analysis (ibid., p. 491–494) of strain from brachiopod deformation.—BFL

03947 **Hoeger, Roger L.** Hydrodynamic study of the western Denver basin, Colorado, *in* Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well, Pt. A: Colorado School Mines Quart., v. 63, no. 1, p. 245–251, illus., 1968.

The original hydrostatic pressure in the fracture system of Precambrian basement rocks in the Rocky Mountain Arsenal well was far below normal. In an effort to understand the reasons for the subnormal pressure, a study of hydrodynamic pressure gradients in overlying sedimentary rocks of the western Denver basin was considered necessary. The following report is the result of an analysis of all available data on the major deep aquifers. The report was prepared for the Colorado School of Mines as a part of the geology study of the Derby earthquakes.—Author's abstract

Hogarth, D. D. *See* Kasowski, M. A. 03665

03681 **Högdahl, Ove T.; Melsom, Sigurd; Bowen, Vaughan T.** Neutron activation analysis of lanthanide elements in sea water, [Chap.] 19 *in* Trace inorganics in water—Am. Chem. Soc., 153d Ann. Mtg., Miami Beach, Fla., 1967, Div. Water, Air and Waste Chemistry Symposium: Washington, D.C., Am. Chem. Soc. (Adv. Chemistry Ser. 73), p. 308–325, illus., tables, 1968.

Neutron activation analyses of 16 samples of sea water (8 in duplicate) taken at six widely spaced stations in the Central Atlantic Ocean between 16° N. and the Equator (depths below 1,000 m) showed that the lanthanide patterns are relatively conservative characteristics of water masses. The differences in lanthanide distribution and total abundance [of rare earths] between different water masses are small but significant.—*from* Authors' abstract

03821 **Hollister, John C.; Weimer, Robert J.** (editors). Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well—Pt. A [papers]: Pt. B, maps: Colorado School Mines Quart., v. 63, no. 1, 251 p., illus., tables, 1968.

The geophysical portion of this study evaluates both the place of origin and the time of occurrence of the earthquakes in the Denver area. The history of earthquake activity in Colorado and its possible relationship to the recent Denver quakes is reviewed and the relation between the Denver quakes and the reservoir into which fluids were injected via the Rocky Mountain Arsenal well is examined in detail. Geologic studies presented in this report describe the regional structure and stratigraphy, surface geology, and regional and local characteristics of the fractured Precambrian rocks into which fluid was injected at the Arsenal well. Papers are cited separately.—KAF

03831 **Holloway, John R.; Burnham, C. Wayne; Millhollen, Gary L.** Generation of H_2O–CO_2 mixtures for use in hydrothermal experimentation: Jour. Geophys. Research, v. 73, no. 20, p. 6598–6600, table, 1968.

A method is described for generating mixtures of H_2O and CO_2 in known proportions inside sealed capsules for use in hydrothermal experiments, which should be useful for studying metamorphic reactions involving CO_2, H_2O or both and melting relations of silicates under conditions in which equilibrium water pressure is less than the total pressure.—DBV

Honea, R. M. *See* Strangway, D. W. 03916

Hoover, James M. *See* Tinoco, Fernando H. 03634

Horai, Ki-iti. *See* Simmons, Gene. 03931

Horn, Paul H. *See* Totten, Robert B. 03506

Horwood, J. L. *See* Keys, J. D. 03760

Hoskin, Charles M. *See* Slatt, Roger M. 03570

Hostetler, P. B. *See* Truesdell, A. H. 03932

03840 **Howard, Keith A.; Offield, Terry W.** Shatter cones at Sierra Madera, Texas: Science, v. 162, no. 3850, p. 261–265, illus., 1968.

Shatter cones abound in the central uplift of Sierra Madera, and they occur as far as 6.5 km from the center. Apical angles average near 90°. Whole cones and full cones represented by diversely oriented cone segments in any structural block show relatively uniform orientations of axes and a dominant direction of point. The cones predate faulting and folding in the central uplift, and, when beds are restored to horizontal, most cones point inward and upward, a pattern that supports the hypothesis of an impact origin.—Authors' abstract

03481 **Howie, R. D.** Stony Creek gas and oil field, New Brunswick, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1819–1832, illus., table, 1968.

The Stony Creek gas and oil field, about 9 miles south of Moncton, New Brunswick, is the only productive field in Canada east of the province of Ontario. Production is from deltaic sandstone beds in the Albert Formation of Mississippian age. The field has an area of only 1830 acres and is on the gently dipping north limb of the Weldon Syncline.—Author's abstract

03855 **Hoyt, John H.** Barrier island formation—Reply [to J. J. Fisher's discussion, 1968]: Geol. Soc. America Bull., v. 79, no. 10, p. 1427–1431, illus., 1968.

In discussing morphology of barrier islands, Fisher (ibid., p. 1421–1426) limits comments to bays, drowned river valleys, and coast-parallel lagoonal tracts and fails to indicate significant differences in islands that suggest diverse origins. Examples are discussed from the Georgia and South Carolina coasts. Hoyt points out that the submergence hypothesis is based upon generally acceptable conditions: submergence has accompanied melting of continental glaciers; and dune and beach ridges, ubiquitous along modern shorelines, form sufficiently rapidly to have been common during Holocene transgression. Decrease in rate of submergence during late Holocene allowed progradation of shoreline and successive dune- and beach-ridge development or both. The barriers are continually modified in response to changing conditions.—VSN

03836 **Hriskevich, M. E.** Petrology of the Nipissing diabase sill of the Cobalt area, Ontario, Canada: Geol. Soc. America Bull., v. 79, no. 10, p. 1387–1403, illus., tables, 1968.

This paper presents a detailed petrographic and mineralogic study of the rocks of the Nipissing diabase sill near Cobalt, Ontario, Canada. The sill has an undulatory form, and the petrology of the sections in the basins differs from that of the arches. Olivine-bearing hypersthene diabase is confined to the basins. Augite, pigeonite (in part inverted), and hypersthene occur in the sill; the systematic manner in which they vary and are related to each other is detailed herein. The diversity of major facies is reasonably explained by gravity control of differentiation accompanied by some lateral movements. Continuous exposures of rock at several mines have facilitated detailed studies.—Author's abstract

03684 **Hsu, Pa Ho.** Interaction between aluminum and phosphate in aqueous solution, [Chap.] 5 *in* Trace inorganics in water—Am. Chem. Soc., 153d Ann. Mtg., Miami Beach, Fla., 1967, Div. Water, Air and Waste Chemistry Symposium: Washington, D.C., Am. Chem. Soc. (Adv. Chemistry Ser. 73), p. 115–127, illus., tables, 1968.

Hydroxy aluminum solutions of basicity (NaOH/Al molar ratio) ranging from 0 to 2.7 were mixed with a NaH_2PO_4 solution to give a H_2PO_4/Al molar ratio varying from 0 to 15. It was found that hydroxy-aluminum polymers and Al^{3+} yielded different reaction products with phosphate. The polymers were completely and immediately precipitated by phosphate at their isoelectric points. This precipitation is interpreted to be a simple "neutralization" of the net positive charge of polymer

by the phosphate anion. Al^{3+} formed soluble complexes with phosphate, no precipitate being observed up to a H_2PO_4/Al molar ratio of 8. In solutions which contain both polymers and Al^{3+}, each reacted with phosphate separately, because a rapid equilibrium between Al^{3+} and polymers does not exist.—*from* Author's abstract

03480 **Hubbert, M. King.** Degree of advancement of petroleum exploration in United States, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 2149–2170, illus., 1968.

Several lines of evidence are consistent in indicating that (1) the peak in time–rate of crude–oil production will probably occur near the end of the 1960 decade and that the ultimate production will be less than 200 billion bbl. (2) The peak in natural gas production will probably occur at the end of the 1970's with the ultimate production being between 900 and 1200 trillion cu ft. (3) Between 68 and 85 percent of the total crude oil has already been discovered. (4) The evidence available offers scant hope that recently postulated future discovery rates in excess of 80 bbl/ft, with attendant discoveries of additional hundreds of billions of barrels of crude oil, during the next two or more billion feet of exploratory drilling will ever, in fact, be realized.—*from* Author's abstract

Hudson, J. D. *See* Busch, F. E. 03530

Hume, David N. *See* Andersen, Neil R. 03645

Hume, David N. *See* Andersen, Neil R. 03680

03816 **Hunt, John M.** How gas and oil form and migrate: World Oil, v. 167, no. 4, p. 140, 145, 148–150, illus., 1968.

The paper summarizes very briefly and simply five factors in the origin and migration of petroleum: chemistry of hydrocarbons; environments of petroleum formation; influence of time, temperature, and sedimentation rates on formation and migration; primary and secondary migration; and metamorphism of petroleum.—MWR

03934 **Hurley, P. M.** Correction to—Absolute abundance and distribution of Rb, K and Sr in the Earth: Geochim. et Cosmochim. Acta, v. 32, no. 9, p. 1025–1030, illus., tables, 1968.

Geochemical probabilities are used to estimate the absolute abundances of K and Rb in the Earth. This leads to a knowledge of the abundance of Sr, which is found to support the meteorite model for the abundance of non–volatile trace elements. Crustal evolution rates are limited by these conclusions.—Author's abstract

Hurley, R. G. *See* Hakkila, E. A. 03298

03678 **Ichiye, Takashi.** Marine geological research and exploration, Chap. 6 *in* UnderSea Technology—Handbook, Directory, 1968: Arlington, Va., Compass Pubs., p. A39–A48, illus., 1968.

Cruises of research vessels and equipment and instruments for marine geology are reviewed. Significant results in the years 1966–1967 include measurements of paleomagnetic reversals in deep–sea sediments, paleotemperature, and manganese–nodule distribution; sea–floor spreading tests along magnetic profiles based on sediment cores as well as paleomagnetism; discovery of a nepheloid layer near the bottom of deep oceans indicating a turbulent layer; bottom–current effects on the continental margins; and discovery of giant ripples.—ESL

Imbimbo, Eugene S. *See* Fabricand, Burton P. 03554

03576 **Inderbitzen, A. L.** A study of the effects of various core samples on mass physical properties in marine sediments: Jour. Sed. Petrology, v. 38, no. 2, p. 473–489, illus., tables, 1968.

Samples from seven corers, from the same location, were measured for shear strength, water content, and unit weight. The latter is least affected by sampling disturbance. No corer was superior in repeatability of measurements. Each corer appeared to yield good results for at least one of the measured properties, but yielded the poorest results on another property. No definite trend between disturbance across a core section could be established in connection with kind of corer, depth in the core, or variability in shear strength. In comparing laboratory data measured on samples obtained with one corer with data obtained by another, a variable factor must be introduced. The factor appears to vary with the property being compared and the depth within the core.—*from* Author's abstract

Ingle, James C., Jr. *See* Asano, Kiyoshi. 03815

03685 **Ingols, Robert S.; Enginun, Mine E.** Biological studies of manganese solution from its dioxide, [Chap.] 7 *in* Trace inorganics in water—Am. Chem. Soc., 153d Ann. Mtg., Miami Beach, Fla., 1967. Div. Water, Air and Waste Chemistry Symposium: Washington, D.C., Am. Chem. Soc. (Adv. Chemistry Ser. 73), p. 143–148, illus., 1968.

Studies of the solution of manganese from manganese dioxide [in fresh water] by reaction with sterile and inoculated bacterial media indicate that the inoculation is unnecessary for the solution. Actually, the growing organisms compete for the reactive capacity of the food in the medium; the more rapidly the organisms develop, the greater is the competitive interference. Under natural conditions [in lake-bottom muds], the organisms contribute to the manganese solution by developing an oxygen free environment for the maintenance of a manganous solution at the neutral pH values typical of natural lakes.—Authors' abstract

03318 **Isenhour, T. L.; Kowalski, B. R.** New excitation source using monoenergetic 477-keV γ-rays from the ^{10}B $(n,\alpha)^{7m}Li \rightarrow {}^{7}Li$ reaction [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 370, 1968.

Jackson, M. L. *See* Roth, C. B. 03805

Jackson, M. L. *See* Syers, J. K. 03933

03939 **Jain, Anant V.; Lipschutz, Michael E.** Implications of shock effects in iron meteorites: Nature, v. 220, no. 5163, p. 139–143, illus., table, 1968.

The shock loading history of iron meteorites seems to alter profoundly their solid state response to annealing at moderate temperatures. This permits certain conclusions to be drawn about the history of these iron meteorites. Textural alterations produced in the laboratory can be compared with those evident in group III iron meteorites. Resemblances strongly suggest that, after shock-loading, the Carthage, Descubridora, Ruff's Mt. and Sams Valley meteoroids were altered by contact for a few days or more with material that was at an effective temperature of about 500°C.—KAF

03269 **Jambor, J. L.; Lachance, G. R.** Bismuthian robinsonite: Canadian Mineralogist, v. 9, pt. 3, p. 426–428, table, 1968.

Robinsonite was known to occur only at the type locality in Pershing County, Nev., and at Madoc, Ontario, until a new locality was found during a study of kobellite (Harris et al, 1968) from Salmo, British Columbia. Microprobe analysis gave Pb 41.5, Bi 22, Sb 20, S 18 percent. X-ray powder diffraction data are tabulated and show a slightly enlarged cell, in keeping with the atomic radius of the substituting bismuth.—ESL

Jambor, J. L. *See* Mulligan, R. 03275

Jambor, J. L. *See* Sabina, Ann P. 03670

03762 **Jambor, J. L.** New lead sulfantimonides from Madoc, Ontario—Pt. 3, Syntheses, paragenesis, origin: Canadian Mineralogist, v. 9, pt. 4, p. 505–521, illus., tables, 1968.

At least 11 artificial sulfosalts have been prepared by heating various mixtures of galena, stibnite, and orpiment in closed tubes. Among these are the new Madoc sulfosalts playfairite, madocite, guettardite, and two lead sulfantimonides which have no mineral counterparts. From oldest to youngest, the depositional sequence at Madoc is sulfides, arsenic-rich sulfosalts, and antimony-rich and copper-bearing sulfosalts. Precipitation of the Pb–Sb–As sulfosalts initially followed a trend of decreasing activity of As_2S_3 and probably terminated with increasing activity of Sb_2S_3 in the system. The observed paragenesis is believed to have resulted principally from the greater solubility of arsenic as compared to antimony, with temperature effects becoming a more important control toward the terminal stages of deposition.—Author's abstract

Jambor, J. L. *See* Harris, D. C. 03820

03594 **James, R. S.** An occurrence of sodalite at the Princess Quarry, Bancroft, Ontario [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 574, 1968.

03758 **Jenne, E. A.** Controls on Mn, Fe, Co, Ni, Cu, and Zn concentrations in soils and water— . . ., [Chap.] 21 *in* Trace inorganics in water—Am. Chem.Soc., 153d Ann. Mtg., Miami Beach, Fla., 1967, Div. Water, Air and Waste Chemistry Symposium: Washington, D.C., Am.Chem.Soc. (Adv.Chemistry Ser. 73), p. 337–387, illus., table, 1968.

It is proposed that the hydrous oxides of Mn and Fe, which are nearly ubiquitous in clays, soils, and sediments, furnish the principal control on fixation of Co, Ni, Cu, and Zn (heavy metals) in soils and fresh-water sediments. Common occurrence of Mn and Fe oxides as coatings allows them to exert chemical activity far out of proportion to their concentrations. Sorption or desorption of the heavy metals occurs in response to: aqueous concentration of the metal; aqueous concentration of other heavy metals; pH; amount and strength of organic chelates and inorganic ion formers present in solution. Other suggested controls are: organic matter; clays; carbonates; precipitation as the discrete oxide or hydroxide. Available information on these controls is inadequate to explain the fixation of Co, Ni, Cu, and Zn.—*from* Author's abstract

03256 **Jodry, R. L.; Henneman, A. B.** Helium, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1970–1982, illus., table, 1968.

Most helium on earth is believed to have originated from decay of radioactive minerals. It is found in minute quantities in most rocks and minerals, but the chief occurrence is in hydrocarbon gases, mainly around Amarillo, Texas. A recent discovery in Saskatchewan may be the first important discovery outside of the United States. The geologic conditions optimum for helium accumulation have been studied and ideas concerning necessary conditions for accumulation have changed in recent years.—*from* Authors' abstract

03309 **Joensuu, Oiva I.** Spectrochemical methods in geochemistry [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 368, 1968.

Johnson, G. G., Jr. *See* Vand, V. 03520

03679 **Johnson, G. Leonard; Jugel, M. Karl.** Recent developments in hydrography, Chap. 5 *in* UnderSea Technology—Handbook, Directory, 1968: Arlington, Va., Compass Pubs., p. A27–A34, illus., table, 1968.

In deep-water hydrography, the sea floor is divisible into three categories: continental margin, ocean basin floor, and midoceanic ridge. The Norwegian-Greenland Sea survey is used as an example of deep-water hydrography using bottom topography, marine geology, and geophysics. Discussion of computerization of data includes terrain analysis and the library of deep-sea soundings. New instruments described are deep-towed transducers, the pulse-compression echo sounder, and narrow-beam echo sounders. New methods of coastal hydrographic surveying are aerial photography and analysis of wave spectra to predict depth.

Several new survey ships and the HYSURCH System, Hydrographic Surveying and Charting System, are described.—ESL

03552 **Johnson, Kent E.** Sedimentary environment of Stanley Group of the Ouachita Mountains of Oklahoma: Jour. Sed. Petrology, v. 38, no. 3, p. 723–733, illus., 1968.

Particular emphasis has been placed upon the sedimentary structures that can be used as paleocurrent indicators. The Stanley Group is interpreted as flysch deposits with the present exposures revealing mainly the axial portion of the trough. The normal environment was one of mud accumulation under reducing conditions in a poorly circulated, possibly deep water basin. Siliceous shales mark occasional, widespread quiescent conditions. Volcanism occurred during the infilling of the trough. Rapid introduction of sand frequently interrupted the normal settling. Turbidity currents, triggered by the instability associated with rapid subsidence and an active source area, brought in the sand from the marginal source areas to the southeast. An axial trend of transport was present and became progressively better developed in the later stages.—*from* Author's abstract

Johnson, M. A. *See* Vary, J. A. 03494

Johnson, P. G. *See* Carver, R. D. 03314

Jones, Bill. *See* Bryant, William R. 03784

03470 **Jones, Fred B., Jr.** East Durant field, Bryan County, Oklahoma, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1467–1475, illus., 1968.

The East Durant field is on a closed anticline beneath an overthrust fault sheet; the field was discovered with the use of a coordinated program of core-drill, seismic, and subsurface exploration. The surface rocks are Comanchean and lie unconformably on beds fromSpringer to Simpson in age. The entire geologic section from Springer to Arbuckle is represented and in some instances is duplicated where thrust faulting has occurred. Productive zones are limited to the Bromide and McLish Formations of the Simpson Group. There are six gas wells and two oil wells. Cumulative production to March 1965 was approximately 6,075,893 Mcf of gas and 105,984 bbls of oil.—*from* Author's abstract

03905 **Jones, J. G.** Pillow lava and pahoehoe: Jour. Geology, v. 76, no. 4, p. 485–488, illus., 1968.

Both pahoehoe (subaerial) and pillow (subaqueous) basaltic flows advance in basically the same manner, that is by extension of bulbous toes, presumably fed from interior master conduits. Snyder and Fraser's conclusion that the similarity between pahoehoe and pillow flows is superficial is questioned.—REW

Joyner, Gerald. *See* Adams, Richard M. 03759

Jugel, M. Karl. *See* Johnson, G. Leonard. 03679

Kaarsberg, Ernest A. *See* Strum, Rolland G. 03677

Kanamori, Hiroo. *See* Anderson, Don L. 03833

03323 **Karr, Clarence, Jr.; Kovach, John J.** Far-infrared spectroscopy of minerals and inorganics [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 355, 1968.

03665 **Kasowski, M. A.; Hogarth, D. D.** Yttrian andradite from the Gatineau Park, Quebec: Canadian Mineralogist, v. 9, pt. 4, p. 552–558, illus., tables, 1968.

Yttrian andradite is a common accessory mineral in granite pegmatites from the southern Gatineau Park, Quebec. Samples from three separate occurrences showed 2.65, 1.23, and 0.74 percent yttrium. These garnets are unusual in being virtually the sole rare earth minerals in the pegmatites and in their lack of cerium and

neodymium. Andradite itself is rare in pegmatites. Possible mechanisms of ionic substitution are $Y^{3+} + (Fe^{3+}, Al^{3+}) \rightarrow Ca^{2+} + Si^{4+}$ and $Mn^{2+} \rightarrow Ca^{2+}$.—Authors' abstract

03556 **Kaye, M. J.; Dunham, A. C.; Hirst, D. M.** A comparison of two methods of quantitative mineralogical analysis of sedimentary rocks: Jour. Sed. Petrology, v. 38, no. 2, p. 675–679, tables, 1968.

An attempt is made to assess the relative merits of quantitative X-ray diffraction analysis and optical modal analyses of sedimentary rocks. Chemical analyses of S and CO_2 enable a direct check of the accuracy of total carbonate and sulphide determinations, while indirect methods based on correlation coefficients are used to check the analyses for total clay minerals. It is concluded that quantitative X-ray diffraction provides the most reliable mineralogical abundance data.—Authors' abstract

Kelly, J. C. *See* Knebel, H. J. 03567

03743 **Kermabon, A.** Note on an article by Andre M. Rosfelder entitled "A tubular spring valve used as a tight and thin-walled core retainer" 1966: Jour. Sed. Petrology, v. 38, no. 2, p. 688, 1968.

Kermabon expresses his doubts that strong torque is not needed in the valve described by Rosfelder (ibid., v. 36, no. 4, p. 973–976, 1966). To be useful and economical, the 'sphincter' type core catchers must be used to close in rather compact layers when, consequently, a rather large amount of energy is required. To operate properly, the lever system used by Rosfelder must be surrounded by sediments presenting some comparison.—MCM

03760 **Keys, J. D.; Horwood, J. L.; Baleshta, T. M.; Cabri, L. J.; Harris, D. C.** Iron–iron interaction in iron-containing zinc sulphide: Canadian Mineralogist, v. 9, pt. 4, p. 453–467, illus., tables, 1968.

The behaviour of iron in ZnS has been studied through effect of iron concentration on magnetic and electrical properties. Synthetic specimens containing 0.09 to 16.6 atom percent iron were found to be homogeneous. At lower iron concentrations, sphalerites are paramagnetic and magnetic susceptibilities vary with iron content in a linear manner; at higher concentrations, they become increasingly antiferromagnetic and susceptibilities vary in a nonlinear manner. Antiferromagnetic behaviour may be like that in Mn-bearing ZnS, the result of magnetic ordering of substitutional iron. Electrical conduction for natural iron-bearing sphalerite is from migration of low-mobility holes rather than electrons, is consistent with the mechanism known as d-band conduction, and is possible in iron-containing ZnS through interaction of Fe^{3+} with Fe^{2+} with Fe^{3+} in tetrahedral or octahedral position.—*from* Authors' abstract

03778 **Kilkenny, John E.** Arthur Frederick Peterson (1911–1967): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 7, p. 1305–1306, portrait, 1968.

Kingston, P. W. *See* VanLoon, J. C. 03648

03672 **Kingston, P. W.** Studies of mineral sulphosalts—[Pt.] 21, Nuffieldite, a new species: Canadian Mineralogist, v. 9, pt. 4, p. 439–452, illus., tables, 1968.

Nuffieldite occurs as prismatic to acicular crystals, up to 3 mm in length, in vugs in narrow quartz veins in the Lime Creek quartz diorite stock near Alice Arm, British Columbia. The mineral is orthorhombic, *Pnam* or $Pna2_1$, with a = 14.61 A, b = 21.38 A, c = 4.03 A. Qualitative analysis revealed lead, bismuth, and copper. Quantitative analyses of these by X-ray spectroscopy, electron microprobe analysis, and atomic absorption spectroscopy agree closely. A colorimetric method was developed for sulphur analysis of samples weighing less than one milligram. The composition is Pb = 40.27, Bi = 37.55, Cu = 5.88, S = 16.30 percent. Calculated density is 7.006, and measured density 7.01.—*from* Author's abstract

03529 **Kirk, Ruth.** Exploring Mount Rainier: Seattle and London, Univ. Washington Press, 91 p., illus., 1968.

Although this is essentially a guidebook to Mount Rainier, the first chapter on geology contains a brief account of the dormant volcano and possibilities of future eruptions, the geologic history of the area before the volcanic cone was formed, the beginning of the volcano, and a description of the glaciers.—MCM

Klein, Edward. *See* LeGeros, Racquel Z. 03324

03325 **Klein, Edward; Trautz, Otto R.; LeGeros, John P.; LeGeros, Racquel Z.** Infrared reflectance spectra of single crystals of apatites [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 357–358, 1968.

03266 **Klein, George deVries.** (editor). Late Paleozoic and Mesozoic continental sedimentation, northeastern North America—A symposium: Geol. Soc. America Spec. Paper 106, 309 p., illus., tables, 1968.

Recently many nonmarine units in the conceptual framework of the northern Appalachians have been reinvestigated. Earlier work stressed regional paleogeography, cyclicity, and mineralogy; the modern approach is to combine sediment texture, primary structures, directional mapping, vertical sequences, and mineral composition to integrate their depositional mechanics and origin. In this volume are nine separately cited papers originally presented at the 1966 meeting of the Northeast Section of the Geological Society of America, which summarize these current investigations. These papers show that two basic continental sedimentation models occur in the northern Appalachians—the Coastal Plain and the Fault Trough.—GDC

03567 **Knebel, H. J.; Kelly, J. C.; Whetten, J. T.** Clay minerals of the Columbia River—A qualitative, quantitative, and statistical evaluation: Jour. Sed. Petrology, v. 38, no. 2, p. 600–611, illus., tables, 1968.

The relative amounts of montmorillonite, illite, and chlorite–kaolinite in the bottom sediments vary considerably between the reservoirs of the Columbia River. Discriminant function analyses indicate significant differences in three areas of the Columbia River based on the variability of clay minerals in six groups of samples from the reservoirs. Samples from tributaries of the lower Columbia differ significantly from all of the other groups. The presence and distribution of two weathering environments within the Columbia basin may account for some of the agreement between observed clay fractions and those predicted from provenance evaluations and may confirm the reliability of discriminant analysis in distinguishing between two groups on the basis of clay variability. The use of discriminant function analysis is potentially valuable for vertical as well as horizontal correlation.—*from* Authors' abstract

Knight, A. S. *See* Blanchard, K. S. 03508

03484 **Knight, G. L.; Beebe, B. W.** Natural gas provinces of North America and estimation of natural gas reserves, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 2027–2034, 1968.

A general summary of the geology of the five natural gas provinces is given. They are: Appalachian synclinorium or basin, Gulf Coast geosyncline or basin, Interior lowlands basins, Intermountain basins, and the Pacific Coast basins. The Hugoton-Panhandle field of Kansas, Oklahoma, and Texas, in the Interior Lowland, is the largest fully developed gas field in the world. The San Juan basin, an intermountain basin, has the second largest gas field in the United States.—HRC

03783 **Knight, Raymond L.** Gas-show pattern at McMullin Ranch field, Sacramento Valley, California: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 7, p. 1152–1161, illus., 1968.

Ditch-gas readings have been sampled through two Upper Cretaceous sandstone zones in 19 wells within and near the McMullin Ranch field in order to define the gas-show pattern associated with a California (Sacramento Valley) dry-gas field. Contour maps of the ditch-gas means for each zone show that the Blewett "5" and upper Tracy sandstone iso-gas-show lines have essentially the same configuration as the structural geometry of the trapping anticlinal fold.—*from* Author's abstract

03888 **Knopoff, Leon.** Pan-American Symposium on the Upper Mantle: Am. Geophys. Union Trans., v. 49, no. 3, p. 555-556, 1968.

The Pan-American Symposium on the Upper Mantle was held in Mexico City from March 18-21, 1968. The conclusions to be drawn from this conference are that the American continents represent a fertile testing ground for many ideas of sea-floor spreading and major motions in the Earth's upper regions.—KAF

03938 **Knowles, Raymond R.; Opdyke, Neil D.** Paleomagnetic results from the Mauch Chunk formation—A test of the origin of curvature in the folded Appalachians of Pennsylvania: Jour. Geophys. Research, v. 73, no. 20, p. 6515-6526, illus., tables, 1968.

Specimens of red siltstone were collected at 25 sites in the Upper Mississippian Mauch Chunk Formation of Pennsylvania, so distributed as to test whether the curve in the folded Appalachians was formed after the magnetization of the beds or whether the original geosyncline was curved in plan. When the beds are rotated back into a horizontal position, the stable components show a decrease in the scatter between the sites, indicating that the direction of magnetization was acquired before the folding. The pole position calculated from the Mauch Chunk is at 43° N., 127° E., in general agreement with other late Paleozoic poles.—*from* Authors' abstract

03893 **Kobayashi, Kazuo; Fuller, M.** Stable remanence and memory of multi-domain materials with special reference to magnetite: Philos. Mag., v. 18, no. 153, p. 601-624, illus., tables, 1968.

The characteristics of memory of remanence across the so-called isotropic point (T_K) in single crystals of magnetite are demonstrated experimentally. It is found that internal stress controls memory and stable remanence in multi-domain materials. Thus there may be difficulties in the determination of ancient geomagnetic field intensity by simple comparison of the intensities of natural remanent and thermoremanent magnetization. Rocks in which internal stress has changed slowly over long periods of time may exhibit a secular change of stable remanence; if this effect is appreciable, the ratios of natural remanent to induced and of thermoremanent to induced magnetization may depend on the age of the rock. If the rock has undergone deformation, the internal stress distribution may be rearranged, changing the direction and intensity of natural remanence.—DBV

03655 **Koch, Donald L.; Strimple, Harrell L.** A new Upper Devonian cystoid attached to a discontinuity surface: Iowa Geol. Survey Rept. Inv. 5, 49 p., illus., table, 1968.

Adocetocystis williamsi Strimple and Koch 1968, n. gen., n. sp., constitutes the third described genus of Callocystitidae bearing a double hydropore; it is further characterized by an ovate theca, four unbranched ambulacra which are apical over most of their length, and an apical mouth, double hydropore and gonopore. This cystoid is part of a biocoenose composed mainly of echinoderms and corals, all of which are attached to a prominent but laterally restricted discontinuity surface, which was probably produced by subaerial erosion. *A. williamsi* is thought to have lived in a shallow water environment with a moderate current.—MST

Koch, Robert C. *See* McCrone, Alistair W. 03561

Koirtyohann, S. R. *See* Pickett, E. E. 03285

03286 **Koirtyohann, S. R.; Pickett, E. E.** Some unusual interference effects in the nitrous oxide–acetylene flame [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 360, 1968.

03568 **Kolpack, Ronald L.; Bell, S. Allen.** Gasometric determination of carbon in sediments by hydroxide absorption: Jour. Sed. Petrology, v. 38, no. 2, p. 617–620, illus., tables, 1968.

A gasometric technique for determining the amount of $CaCO_3$ in sediments has been adapted to the commercially-available LECO (Laboratory Equipment Corporation) machine used to determine the total carbon content. The volumetric absorption of CO_2 by KOH in the method described is both accurate and precise. Organic carbon values can also be obtained by difference and are more reliable than values obtained by separate techniques. One technician can analyze at least 75 samples in an 8-hour day. Use of sediment pellets rather than powdered material contributes to greater accuracy, because error in sample weight caused by an increase in the moisture content is reduced.—Authors' abstract

03625 **Konizeski, R. L.; Brietkrietz, Alex; McMurtrey, R. G.** Geology and ground-water resources of the Kalispell Valley, northwestern Montana: Montana Bur. Mines and Geology Bull. 68, 42 p., illus., tables, geol. map, 1968.

In this Paleocene–Eocene graben in Precambrian rocks, partly filled by Tertiary sediments, remnants of Pleistocene erosion were buried by glacial till and Lake Missoula deposits; with lake recession, the Flathead River and tributaries entrenched their courses about 100 feet and floodplains were subsequently broadened. Maximum gravity-calculated depth of fill is 4,800 feet. Precambrian bedrock yields a little water from joints and fractures; Pleistocene artesian aquifers supply many wells, the deeper of which flow as much as 225 gpm. Water is recharged along mountain fronts, and discharged near the center of the valley by upward percolation. Small-yield perched aquifers of Pleistocene age are: dune and lacustrine sand on east and central terraces, glacial outwash to the northwest, and drift in the kame-and-kettle area. Floodplain gravel north of Kalispell has the greatest potential.—GDC

03769 **Konizeski, Richard L.** The problem in Montana—The physical aspects, *in* Symposium on water resources: Montana Acad. Sci. Proc. 1967, v. 27, p. 8–14, 1968.

More than 82 percent of the State lies within the Missouri River basin, but provides only two-fifths of the annual runoff. Irrigation is the greatest user of water and the most wasteful, due to evaporation. Evaporation loss from large reservoirs is 1.3 million acre feet, and within 50 to 100 years these will be filled with silt. Montana has only begun to develop her ground-water resource. Valley fill in intermontane valleys would supply wells yielding several thousand gallons per minute; artesian wells in fractured bedrock in the mountains supply sufficient water for domestic and livestock use; formations exposed on flanks of central isolated ranges often contain large quantities of ground water; and the eastern and central high plains, underlain by sedimentary rocks with sandstones not too deeply buried, would supply moderate to large amounts of water. Advantages of ground-water storage relative to surface-water are listed.—ESL

Koshy, Jacob. *See* Patel, A. R. 03668

Kosminskaya, I. P. *See* Belousov, V. V. 03644

Kosminskaya, I. P. *See* Gaynanov, A. G. 03817

Kovach, John J. *See* Karr, Clarence, Jr. 03323

03915 **Kovach, R. L.; Glover, P.** Travel times of PKP in the range $115° \leq \Delta \leq 140°$: Royal Astron. Soc. Geophys. Jour., v. 15, no. 4, p. 367–376, illus., tables, 1968.

About 500 observations of PKP in the range $\Delta = 115°$ to 140° have been examined statistically to yield a set of empirical traveltimes. Observations of the DE branch (PKIKP) fit the form $t = 9092.5 \sec + 1.876\Delta$, later by 1.8 to 1.0 sec than the JB

traveltimes. The mean residual of all observations of PKIKP from nuclear explosions against the empirical times does not significantly differ from zero emphasizing that average PKIKP times for a reference Earth are now satisfactorily known. In the interval $\Delta = 125°$ to $140°$, observations preceding the DE branch satisfy the relationship $t = 1145.0 + 2.2\ (\Delta - 132.5°)$ with a large standard error; these probably correspond to one or more precursor branches to the DE branch.—DBV

Kowalski, B. R. *See* Isenhour, T. L. 03318

03745 **Kraft, John C.** Coastal sedimentary environments, Lewes–Rehoboth Beach, Delaware—Soc. Econ. Paleontologists and Mineralogists, Northeastern Sec., 1968 Field trip: Newark, Del., Univ. Delaware Dept. Geology, [13] p., illus., 1968.

To better understand the tectonic and stratigraphic framework of the sediments which make up the Atlantic coastal geosyncline, many varied sedimentary environments of Holocene deposition within a small area in southern Delaware, showing intricate sediment and microfaunal facies relationships, are under study. Environments include restricted bays; inlets from the open marine with tidal deltas, baymouth bars and dunes; near–shore inner neritic; marshes and tidal creeks; spit–dune–marsh complex of Cape Henlopen rapidly eroding towards the west and accreting towards the north; and transgressive beaches and marsh fringes of Delaware Bay. Preliminary results, summarized briefly, already conflict with some published interpretations. Two abstracts of recently presented papers are reprinted.—GDC

03547 **Krinsley, David; Donahue, Jack.** Diagenetic surface textures on quartz grains in limestone: Jour. Sed. Petrology, v. 38, no. 3, p. 859–862, illus., 1968.

Quartz sand grains floating in limestone (Cambro–Ordovician and Lower Devonian) were examined by electron microscopy. Four classes of diagenetic surface textures were observed: crystal surfaces, solution surfaces, pressure solution striations, and fracture surfaces. These features result from pore water solution and deposition, and from grain movements during diagenesis.—Authors' abstract

Krishnaswami, S. P. *See* Sharma, M. R. 03560

03543 **Kuenen, Ph. H.** Settling convection and grain–size analysis: Jour. Sed. Petrology, v. 38, no. 3, p. 817–831, illus., tables, 1968.

Grain–size analysis by settling techniques presupposes free sinking of particles. Settling convection is a current system set up by different densities of clouds in a settling suspension. Settling convection tends to augment the sinking velocity of sand grains released at the surface, especially in samples with a narrow range in size and also for particles of less than 0.1–0.05 mm. Hence, the usefulness of various types of sedimentation analyzers based on sample introduction from above is restricted to sizes above 50 microns. Settling convection also renders ineffective counter–current methods (elutriators) in water. Elutriation in air is inapplicable for lutum particles that have been wet, hence for most natural sediments except eolian deposits.—*from* Author's abstract

03620 **Kuenen, Ph. H.** So–called turbidite structures: Jour. Sed. Petrology, v. 38, no. 3, p. 943–945, illus., 1968.

The term "turbidite structures" recently used by Sen (1967) is better avoided, because only a combination of features together with the absence of others can be diagnostic. The distinctions in meaning between the terms "turbidites" and "fluviatile deposits" should not be confused. The explanation of convolute lamination by exaggeration of ripple mark is supportd by experimental results.—Author's abstract

03465 **Kupfer, Donald H.** Relationship of internal to external structure of salt domes, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 79–89, illus., 1968.

Internally, salt stocks consist of isoclinal, attenuated, vertically plunging, refolded, and faulted folds resembling those in a handkerchief drawn vertically from the center

through a small ring. Folding is by flowage, not flexural bending; folds are correspondingly complex and attenuated, but uniaxial. Interbedded detrital sediments and nonhalite salts may have been eliminated during movement. Strain hardening of halite crystals as well as differential sedimentation rates may have caused movements to be intermittent in space as well as in time, and strongly affected internal structures. External structures, such as grabens and faults, may be related to internal structures, such as faults, shears, and zones of differential movement.—*from* Author's abstract

Kurentsova, N. A. *See* Sakhno, V. G. 03818

03259 **Kurtz, L. T.; Tandon, H. L. S.; Marcusiu, E. C.** Determination of aluminum in the presence of fluoride by emission spectroscopy: Appl. Spectroscopy, v. 22, no. 4, p. 282–285, illus., tables, 1968.

Fluoride greater than 0.1*N* interfered negatively in the determination of Al by the rotating-disk-electrode technique. Fluoride interference was eliminated by the addition of H_3BO_3. Aluminum in the 1–100 ppm range was successfully determined in the presence of 0.25*N* fluoride by making the solutions 2.5 percent in H_3BO_3. The coefficients of variation among six determinations for solutions containing 10 and 100 ppm gal were 3.0 prcent and 0.9 percent, respectively. Recovery of known amounts of Al added to fluoride-extracts of soils ranged from 98.4 percent to 102.2 percent. The proposed method thus gave acceptable accuracy and precision. The method is simple and rapid since it does not require the removal of fluoride by distillation as H_2SiF_6 nor does it prevent the determination of Si in the same sample.—Authors' abstract

03595 **Kwak, T.** Partition coefficients as metamorphic indicators in rocks from Sudbury, Ontario [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 574, 1968.

Lachance, G. R. *See* Jambor, J. L. 03269

Lachance, G. R. *See* Harris, D. C. 03820

03312 **Laidley, Richard A.** X-ray fluorescence analysis of rock samples as applied to geological problems [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 369, 1968.

03559 **Lajoie, Jean.** Dispersal and petrology of the Silurian Val Brillant and Robitaille sandstones, Appalachians, Quebec: Jour. Sed. Petrology, v. 38, no. 2, p. 643–647, illus., 1968.

Crossbedding measurements in the Val Brillant and Robitaille Formations suggest that the sand fraction of these beds was derived from two dispersal centers located west-northwest and north of the present Silurian outcrop belt. Some aspects of the textural and mineralogical maturity of the distribution of crossbedding azimuths and the presence of marine faunas in the sandstones indicate that the sands were deposited in a shallow marine environment of high energy level.—Author's abstract

03926 **Lambert, I. B.; Wyllie, P. J.** Stability of hornblende and a model for the low velocity zone: Nature, v. 219, no. 5160, p. 1240–1241, illus., 1968.

Evidence relating to hornblende stability has been obtained in experiments which extend the phase relationships for calc-alkaline rock series to upper mantle pressures, in the presence of excess water. Data indicate that hornblende-garnet peridotite can exist beneath the shields to a maximum depth of about 80 km; hornblende-spinel peridotite can exist to a maximum depth beneath oceanic regions of about 60 km. Phlogopite is the only other hydrous mineral normally considered in mantle mineralogy, and preliminary results by Kushiro and others (1967) indicate that with the continental shield geotherm phlogopite is unstable at pressures corresponding to depths greater than 150 km.—KAF

03697 **Lambert, T. W.** Availability of ground water in the Hickman quadrangle, Kentucky-Missouri-Tennessee: U.S. Geol. Survey Hydrol. Inv. Atlas HA-181, scale 1:24,000, section, text, 1968.

An abundance of ground water for domestic, irrigation, and industrial supplies is available in west-central Fulton County. Most important aquifers are Quaternary alluvial deposits and Eocene sands; less important are Pliocene(?) gravel or silt, Cretaceous sands, and Paleozoic limestone and dolomite. Quality of water from alluvium is adequate for most uses, although some objectionable constituents are present; water is very hard, dissolved solids content ranges from 292–536 ppm, iron and manganese are present in objectionable amounts, and shallow wells are susceptible to pollution. Quality of water from Pliocene(?) gravel is similar to that of the alluvium. Water from Eocene sands is excellent in quality which improves with depth. A table shows iron content and hydrogen-ion concentration.—MCM

03699 **Lambert, T. W.** Availability of ground water in the parts of the Wickliffe and Wickliffe NW quadrangles, in Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-185, scale 1:24,000, text, 1968.

Ground water resources in the Wickliffe area are significant but have not been fully developed. Important aquifers are Paleozoic chert and limestone which may be a large potential source; Late Cretaceous and Eocene sands, the latter yielding large quantities of good-quality water; and Quaternary alluvium, a potential aquifer of major industrial importance. Development of supplies along the alluvial valley faces the problems of annual spring flooding of bottom lands and high iron and manganese content of water from the alluvium. Large-capacity wells tapping Eocene and alluvial aquifers would probably be capable of supplying all needs in the foreseeable future. Chemical quality of ground water is generally good, except for high concentration of iron and manganese in some aquifers.—MCM

03910 **Larimer, John W.** An experimental investigation of oldhamite, CaS, and the petrologic significance of oldhamite in meteorites: Geochim. et Cosmochim. Acta, v. 32, no. 9, p. 965–982, illus., tables, 1968.

Oldhamite, a mineral found only in enstatite-rich stony meteorites, was studied under controlled atmospheric and temperature conditions over the pO_2 range 10^{-15} to 10^{-10} atm and at temperatures between 800° and 1000°C. A maximum upper stability limit was determined and the results are expressed by the equation: $\log pO_2 = 8.58 - 25{,}350/T$. These results may be used to estimate (1) the temperature at which a meteorite last equilibrated and (2) the composition of the coexisting gas phase during the formation of enstatite chondrites. For the Jajh deh Kot Lalu enstatite chondrite, the temperature at which it last equilibrated is estimated to be 720±140°C. The presence of CaS, graphite, metallic Si, and Fe poor pyroxene indicates that the coexisting gas phase during the formation of enstatite chondrites strongly resembles a gas of cosmic composition.—*from* Author's abstract

03918 **Larsen, J. C.** Electric and magnetic fields induced by deep sea tides: Royal Astron. Soc. Geophys. Jour., v. 16, no. 1, p. 47–70, illus., tables, 1968.

A lunar semidiurnal variation (12.4206-h period) induced by tides in the deep ocean is demonstrated in observations made off the California coast, on the California coast, and on San Miguel Island in the Azores. Comparison with simultaneous continental magnetic measurements permits an estimation of that part of the variation due to a lunar ionospheric oscillation. The observed variation on the sea floor and on the coast agrees well with tidal induced fields computed for a model which assumes: (1) a flat semi-infinite ocean of uniform depth and conductivity, rotating at a uniform rate; (2) a nonconducting atmosphere, continent, and upper mantle; and (3) superconducting mantle at uniform depth beneath the ocean. The variation observed on San Miguel agrees qualitatively with tidal induced fields computed for an island model under certain assumptions.—DBV

Larson, D. B. *See* Cherry, J. T. 03810

03912 **Larson, E. E.; Strangway, D. W.** Discussion [of] "Correlation of petrology and natural magnetic polarity in Columbia Plateau basalts" by R. L. Wilson and N. D. Watkins [1967]: Royal Astron. Soc. Geophys. Jour., v. 15, no. 4, p. 437–441, illus., 1968.

Wilson and Watkins (ibid., v. 12, no. 4, p. 405–424, 1967) contend that samples showing normal polarity tend to have ferrimagnetic oxides with oxidational states, and reverse polarity samples to have high oxidational states. They accept the concept that the magnetic field has reversed and are forced to the conclusion that there is a causal relationship between the geomagnetic polarity and oxidation processes in magmas. Of the 11 sites discussed it is clear that the sampling has been from three distinct units so that the samples are not independent.—DBV

Larson, E. E. *See* Strangway, D. W. 03916

03612 **Larson, Lawrence T.** Mineral resources summary of the Hustburg quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 5 p., 1968.

Sand and gravel are found in alluvial deposits along the flood plains and in beds of the Tennessee River and its larger tributaries, and in older fluvial deposits above the levels of present flood plains in the Hustburg quadrangle. No chert has been mined but most of the quadrangle is underlain by the Fort Payne Formation which in other areas has been mined for chert. This summary accompanies Tennessee Div. Geology Geol. Map GM 31-NW by R. H. Barnes (cited separately).—MCM

03566 **Laury, Robert L.** Sedimentology of the Pleasantview Sandstone, southern Iowa and western Illinois: Jour. Sed. Petrology, v. 38, no. 2, p. 568–599 illis., tables, 1968.

The Pleasantview Sandstone has a thick, variably bedded, elongate channel phase and a thin, uniformly thin-bedded, widespread sheet phase. The latter is truncated by the former, hence is older. Various details are discussed. Channels carrying the Pleasantview detritus were eroded, predominantly subaerially, to depths of 70 to 80 feet, as distributaries across a swamp-or marsh-covered deltaic plain. Channel filling was by point bar and/or nonmarine infilling after channel abandonment. Texturally, the sheet phase sands are finer than the channel sands. Excluding matrix, the modal constituents show negligible variation from Iowa to Illinois, and between sheet and channel sands, and little compositional variation from other major Pennsylvanian sandstones of the Eastern Interior Basin.—*from* Author's abstract

03738 **Laverdière, Camille; Bernard, Claude; Dionne, Jean-Claude.** Les types de broutures glaciaires (glacial chattermarks)—[Pt.] 1, Classification et nomenclature franco-anglaise [with English and German abs.]: Rev. Géographie Montréal, v. 22, no. 1, p. 21–33, illus., 1968.

Chattermarks result from stress-and-strain action produced on bedrock surface by boulders and cobbles dragged in basal ice; curved chips are removed in most instances, and sometimes the tool itself is chattermarked. On the basis of their shape, these microforms are here classified as *chattering fractures*, *convex* and *concave chattermarks* with three types of floors, and *chonchoidal chattermarks*; these markings often can be found associated with glacial grooves. This classification is presented with a key. In the literature, the names are often used interchangeably. Clear and simple terms are here suggested for the French and English languages, on the basis of the shape of chattermarks regardless of their structure.—*from* Authors' abstract

03873 **Lawrence, David R.** Taphonomy and information losses in fossil communities: Geol. Soc. America Bull., v. 79, no. 10, p. 1315–1330, illus., tables, 1968.

Taphonomy explores post-mortem relations between organic remains and their environment. Paleoecologists must first be taphonomists. Two types of post mortem events cause information loss and thus hamper analysis of fossil communities: (1) nonpreservation (2) transport away from life setting. Data on either *potential* information loss through nonpreservation, or *actual* loss, are not numerous. Actual losses can be estimated for oyster communities from the Atlantic Coastal Plain in North Carolina. An Oligocene *Crassostrea gigantissima* (Finch) community at Belgrade contains about 18 megascopic species. A Recent minimal *C. virginica* (Gmelin) community from the Beaufort area includes 80 megascopic species. This suggests that over 75 percent of the species in the Oligocene community were not preserved.—ATO

LeGeros, John P. *See* LeGeros, Racquel Z. 03324

LeGeros, John P. *See* Klein, Edward. 03325

03324 **LeGeros, Racquel Z.; Trautz, Otto R.; LeGeros, John P.; Klein, Edward.** Spectral properties of carbonate in carbonate-apatites [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 357, 1968.

LeGeros, Racquel Z. *See* Klein, Edward. 03325

03690 **Lehmann, H.** Diskussionsbermerkungen [of "Physiographic and geologic control in development of Cuban mogotes" by V. Panoš and O. Štelcl, 1968]: Zeitschr. Geomorphologie, new ser., v. 12, no. 2, p. 171–173, 1968.

The karst of western Cuba exhibits an ancient erosion surface, probably from Miocene time; at the present time karst formation is proceeding vigorously. Lehmann sums up the discussion by Gerstenhauer and reply by Panoš and Štelcl and examines the origin of individual features against a broad background drawn from many parts of the world.—JWC

03262 **Leighton, Morris M.** The Iowan glacial drift sheets of Iowa and Illinois: Jour. Geology, v. 76, no. 3, p. 259–279, illus., tables, 1968.

Iowan drift of Iowa and Illinois was deposited by two different lobes, from the Keewatin and Labradorean ice centers, respectively; the Labradorean lobe reached the Mississippi River later than the Keewatin. Drifts of the two lobes differ, notably in lithology and topography. Detailed stratigraphic studies of drift and loess deposits of the region are cited to support an early Wisconsinan age for Iowan drift and a standard classification of the lower Wisconsinan consisting of: Farmdale glacial substage, Farm Creek intraglacial, Iowan glacial substage, Gardena intraglacial, and Tazewell glacial substage.—DRM

LeRoy, L. W. *See* Lickus, R. J. 03827

03487 **Leslie, Gordon A.** Gas reserves in Western Canada, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 2114–2136, illus., tables, 1968.

Of the three western Canadian provinces, Alberta is in the most advanced state of exploration. British Columbia is second in importance, and Saskatchewan has neither large reserves nor a potential of a large undiscovered supply. The Yukon and Northwest Territories are essentially unexplored. Current trends show that in the future carbonate reservoirs of Triassic, Permian–Pennsylvanian, Mississippian, and Devonian will become increasingly predominant as sources of natural gas in comparison to the gas-producing sandstone beds of the Cretaceous, Jurassic, and Triassic. The potential ultimate discovery could be 240 to 300 trillion cubic feet of gas, including Yukon and Northwest Territories, but excluding the Arctic Islands and continental shelves.—*from* Author's abstract

03797 **Lespérance, Pierre J.** Ordovician and Silurian trilobite faunas of the White Head Formation, Percé region, Quebec: Jour. Paleontology, v. 42, no. 3, p. 811–826, illus., 1968.

Distinctive trilobite faunas of Ordovician and Silurian age can be recognized. An Upper Caradoc fauna is based on graptolites. Two Lower or Middle Ashgill trilobite faunas can be separated: a lower *Stenopareia* and an upper *Remipyga* fauna. An Upper Ashgill, or *Dalmanitina* fauna, is reported for the first time in the New World. Silurian fossils, recognized for the first time in the White Head, can be divided into a Lower Llandovery and an undifferentiated (no younger than middle Upper) Llandovery fauna. Classification of the Phacopidae is reviewed; *Phacopidella* is removed from the family, and *Eophacops* is considered a junior synonym of *Denckmannites*. Two new genera and species are described: *Murphycops skidmorei* (Phacopinae), and *Portaginus robustus* (Illaenacea) as the type of a new family, Portaginidae.—*from* Author's abstract

03856 **Leutze, Willard P.** Stratigraphy and paleoenvironment of the phosphatic Miocene strata of North Carolina—Discussion [of paper by T. G. Gibson, 1967]: Geol. Soc. America Bull., v. 79, no. 10, p. 1433–1436, 1968.

It is pointed out that depth is only one of many environmental factors governing the microfauna of any given portion of the sea. Because of the multiple variables, researchers familiar with living Foraminifera have refused to designate sharply defined depth boundaries for species. Gibson (ibid., v. 78, no. 2321–2328, 1967) gives almost no information to indicate that any of his Miocene samples were deposited in waters as deep as 100 m, in fact his data are suggestive of no more than a 10-to-20 m depth, although his estimates are about ten times as deep. It is concluded that few paleontologists have enough training in ecology and experience with modern faunas to qualify as paleoecologists.—VSN

03765 **Leve, Gilbert W.** Reconnaissance of the ground-water resources of Baker County, Florida: Florida Div. Geology Rept. Inv. 52, 24 p., illus., tables, 1968.

Water supplies of Baker County are obtained from the water-table, shallow artesian, and Floridan aquifers; the latter is the greatest potential source of ground water. The Floridan aquifer, an Eocene limestone underlying the whole county, is 750 to 1,000 feet thick and is recharged to the south of the area and possibly in the southern part. Its artesian pressure fluctuates seasonally from changes in the rate of recharge. Water from the water-table and shallow artesian aquifers is softer and less mineralized than that from the Floridan aquifer but it contains a higher concentration of iron.—MST

Levier, W. A. *See* Vita, O. A. 03250

03596 **Libby, W. G.** Petrography of the Wark-Colquitz complex, southern Vancouver Island, British Columbia [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 575, 1968.

03827 **Lickus, R. J.; LeRoy, L. W.** Precambrian structure and stratigraphy along the mountain front west of Golden, Jefferson County, Colorado—A reconnaissance study, *in* Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well, Pt. A: Colorado School Mines Quart., v. 63, no. 1, p. 129–165, illus., geol. map, 1968.

The Precambrian rocks in the area mapped are divisible into 12 units, with east-west facies changes occurring in several of these. Foliation on the limbs of folds is parallel to bedding and strikes approximately E–W. The major fault zones of the area have a northwest-southeast trend, whereas the major folds extend northeast-southwest. The fault zones possess high permeability. Comparable zones could be present in the Arsenal well area, but the writers are not convinced that fluid injection into the well is responsible for the earth tremors of the Denver area.—KAF

03945 **Liebermann, Robert C.; Schreiber, Edward.** Elastic constants of polycrystalline hematite as a function of pressure to 3 kilobars: Jour. Geophys. Research, v. 73, no. 20, p. 6585–6590, illus., tables, 1968.

New data on the elastic constants of polycrystalline hematite (α-Fe_2O_3) are reported. These results are compared with values reported by previous investigators. The adiabatic bulk modulus and its pressure derivative at zero pressure are 2066 kb and 4.53. A Murnaghan volume-pressure trajectory derived from these ultrasonic data is compared with the existing static compression and shock-wave data for hematite.—Authors' abstract

Linde, R. K. *See* Wong, J. Y. 03925

03786 **Lineback, Jerry A.** Subdivisions and depositional environments of New Albany Shale (Devonian–Mississippian) in Indiana: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 7, p. 1291–1303, illus., 1968.

The New Albany Shale in Indiana is dominantly brownish-black, carbon-rich quartzose, dolomitic, pyritic shale. Greenish-gray carbon-poor shale, dolomite and

sandstone also are present. In descending order, the Clegg Creek Member, Camp Run Member, Morgan Trail Member, Selmier Member, and Blocher Member are named. The lower two members are widely traceable in the subsurface. The Antrim Shale, Ellsworth Shale, and Sunbury Shale, together equivalent to the New Albany, are recognized in the Michigan basin of northern Indiana. The New Albany Shale was deposited in a widespread inland sea, characterized by quiet water that probably was deep in places. The organic matter was derived from a floating mat of algae and accumulated under reducing bottom conditions that were inimical to benthonic faunas.—*from* Author's abstract

Lipschutz, Michael E. *See* Jain, Anant V. 03939

Litteral, E. *See* Vita, O. A. 03250

03490 **Lockett, Robert.** Production of gas in northern Cincinnati arch province, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1716–1745, illus., tables, 1968.

The northern Cincinnati arch is a continuous anticlinal trend approximately parallel with the Appalachian Mountains. There are two independent domes along the crest—Nashville dome in Tennessee and Jessamine dome in central Kentucky. Sedimentary rocks in an essentially normal sequence, range from Upper Cambrian or possibly older to the Dunkard Series (Permian), and these rocks contain many gas- and oil-bearing units. A summary of such occurrences in each system is given with examples. Gas storage is an important use of many of the depleted structures.—HRC

Lohnes, R. A. *See* Handy, R. L. 03267

03271 **Lohnes, R. A.; Handy, R. L.** Slope angles in friable loess: Jour. Geology, v. 76, no. 3, p. 247–258, illus., tables, 1968.

Measured angles of 37 loess slopes in western Iowa show modes near the theoretically expectable angles of cleavage failure (77°), internal friction (51°), and the angle of repose (38°). The vertical cleavage, frequently noted in standing faces of loess, is attributed to tension in the facial layer as required by the Rankine theory, and may be observed in other fine-grained materials besides loess. Shear strength tests in boreholes at six sites showed no consistent differences between horizontal and vertical shear strength.—REW

Lohnes, R. A. *See* Fox, N. S. 03641

Loleit, A. J. *See* Picard, M. Dane. 03512

03676 **Lotan, James E.; Shetron, Stephen G.** Characteristics of drumlins in Leelanau County, Michigan: Michigan Acad. Sci., Arts and Letters Papers 1967, v. 53, p. 79–89, illus., tables, 1968.

Analyses of topographic maps and field observations have delineated two drumlin fields in Leelanau County, Michigan—the Northport field which contains 223 drumlins and the West Leelanau field containing 87 drumlins. A statistical analysis of characteristics indicates that the two fields differ significantly in azimuth, length, and length/width ratio. Composition of the drumlins is an assortment of material consisting of Valders drift, stratified sand and gravel, and pockets of pre-Valders red lacustrine clay. Till fabric, pebble lithology, particle size distribution of drift matrix, and color all indicate they are not bedrock controlled. Their orientation is generally in harmony with the southerly flow of Valders ice.—BSH

Lotse, E. G. *See* Roth, C. B. 03805

Lott, Peter F. *See* Wiersma, Lawrence D. 03647

Lucas, George B. *See* Haun, John D. 03482

03546 **Lucia, F. J.** Recent sediments and diagenesis of south Bonaire, Netherlands Antilles: Jour. Sed. Petrology, v. 38, no. 3, p. 845–858, illus., 1968.

The Recent sediments of south Bonaire are filling a depression in the Pleistocene surface. The general sedimentation and diagenetic history are as follows: (a) deposition of a *Halimeda* grainstone; (b) deposition of a lithoclastic sediment with clay beds and cementation of this sediment to form a lacy carbonate crust; (c) deposition of an intertidal pelleted lime mud; and (d) bedded gypsum deposition and incipient dolomitization of the pelleted lime mud. Based on the similarity between the texture of Recent gypsum and anhydrite and subsurface anhydrite, it is hypothesized that subsurface anhydrite represents anhydrite formed near the surface or anhydrite replacing gypsum formed near the surface.—Author's abstrac

Lumsden, David N. *See* Pittman, Edward D. 03553

03658 **MacDonald, George F.** Debert—A palaeo-Indian site in central Nova Scotia [with French abs.]: Canada Natl. Mus. Anthropology Papers, no. 16, 207 p., illus., tables, 1968.

The geological conditions of this early man site are described. The site is three miles south of the town of Debert in Colchester County. Bedrock is Annapolis Sandstone of Triassic age, overlain by glacial till of the Huron advance. Above the till is laminated and bedded sand of uncertain origin with the greatest thickness 32 inches: ventifacts between this sand and the till would indicate an interval of erosion between the two. Over the laminated sand is structureless sand, 12 to 24 inches thick which is probably the result of organic reworking of the underlying laminated sand. The artifacts from the site are in this material alone. Radiocarbon dates of the artifacts and charcoal give an overall average date for the site as 10,600±47 years B.P. Cold-climate animal remains suggest that the ice front was not far distant at the time.—HRC

03562 **Macintyre, I. G.; Mountjoy, E. W.; D'Anglejan, B. F.** An occurrence of submarine cementation of carbonate sediments off the west coast of Barbados, W. I.: Jour. Sed. Petrology, v. 38, no. 2, p. 660–664, illus., tables, 1968.

Subsea cementation of carbonate sediments was observed at depths of about 50 feet on a submerged barrier reef off the west coast of Barbados, W.I. The calcite cement is attributed to the burrowing of the pelecypod *Gastrochaena hians* through carbonate sands trapped in a sponge mat. Because of the difficulty in recognizing the cemented sediment on the sea floor, its areal distribution could not be estimated.—Authors' abstract

MacLaren, A. S. *See* Morley, L. W. 03771

03822 **Major, Maurice W.; Simon, Ruth B.** A seismic study of the Denver (Derby) earthquakes, *in* Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well, Pt. A: Colorado School Mines Quart., v. 63, no. 1, p. 9–55, illus., tables, 1968.

This report discusses the Denver earthquakes over the period January 1, 1962 to September 1, 1967, and their relation to the Rocky Mountain Arsenal disposal well. Conclusions are: (1) The quality of original correlation between fluid injection and earthquake occurrence has been reduced by seismic events of the past 18 months when no injection has taken place. (2) The earthquakes have a normal frequency vs. magnitude distribution; the past occurrence of many small shocks cannot be considered to have reduced the probability of the occurrence of a larger event. (3) The zone of earthquake hypocenters has a sharply defined southern limit, more diffuse northwestern limit, and no symmetry about the well. (4) The two largest quakes resulted from strain release via rupture which began at 2–2 3/4 km north and 4 1/2–6 1/2 km west of the disposal well and traveled N. 70 W. for about 10 km.—KAF

Makarova, Zh. A. *See* Sakhno, V. G. 03818

03813 **Malahoff, Alexander; Moberly, Ralph, Jr.** Effects of structure on the gravity field of Wyoming: Geophysics, v. 33, no. 5, p. 781–804, illus., table, 1968.

A density model of the upper crust of Wyoming, computed without reference to gravity data, when compared with the observed gravity field, demonstrates that: (1) Existing measurements and theory of change of sedimentary rock density with depth of burial are satisfactory for gravity interpretation. (2) Gravity stations established over sedimentary basins are generally as satisfactory as those on basement rock outcrops for depicting regional Bouguer gravity trends. (3) The Laramide deformation was mainly germanotype. The regional gradient in Bouguer gravity across Wyoming has increasingly negative values to the southwest. Interpretation of the gravity field indicates that Laramide structural blocks are bounded by near-vertical faults extending into the upper mantle, and that the uplifted blocks are undercompensated.—*from* Authors' abstract

03757 **Mallory, Edward C., Jr.** A thioacetamide-precipitation procedure for determining trace elements in water, [Chap.] 17 *in* Trace inorganics in water—Am. Chem. Soc., 153d Ann. Mtg., Miami Beach, Fla., 1967, Div. Water, Air and Waste Chemistry Symposium: Washington, D.C., Am. Chem. Soc. (Adv. Chemistry Ser. 73), p. 281–295, tables, 1968.

When minor elements in water residues are determined spectrographically, major constituents sometimes interfere by producing unpredictable matrix effects, and by diluting the minor elements below limits of detection. Precipitation of minor elements in waters can be used to remove major elements and to concentrate minor ones before [emission] spectrographic analysis. In this procedure, thioacetamide is used as precipitant for both the acid and the ammoniacal sulfide groups. Palladium is added to the samples as an internal standard. Tin is added to the acid sulfide group as a spectrographic buffer and coprecipitant; indium is used for the same purposes with the ammoniacal sulfide group. Quantitative precipitations are obtained for Al, Sb, As, Be, Bi, Cd, Cr, Cu, Fe, Pb, La, Ti, Zn, and Zr.—*from* Author's abstract

Malmstadt, H. V. *See* Hieftje, G. M. 03290

03536 **Manheim, F. T.** Disposable syringe techniques for obtaining small quantities of pore water from unconsolidated sediments: Jour. Sed. Petrology, v. 38, no. 2, p. 666–668, illus., 1968.

Disposable plastic syringes, fitted with screen discs and circles of filter paper, can be used to extract small amounts of pore water from unconsolidated sediments. A wooden screw frame or large C clamp supplies pressure for field use. Supplementary techniques enable small volumes of fluid to be recovered and handled easily. The Goldberg compensating refractometer provides a useful companion tool for field studies. It can determine, in less than a minute, total dissolved solids in brackish to salt waters to an accuracy of 0.5 parts per thousand on a drop of fluid.—Author's abstract

03291 **Manning, David C.; Slavin, Walter.** Recent developments in sampling techniques for atomic absorption spectroscopy [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 361, 1968.

03270 **Manning, P. G.** Optical absorption studies of the mixed-ion (Cu and Al) doping of sphalerite: Canadian Mineralogist, v. 9, pt. 3, p. 429–433, illus., 1968.

Experimental studies to determine whether the presence of aluminum cations can influence the valence state or siting of Cu in sphalerite are described. Absorption spectra of the doped sphalerites are shown in diagrams. It is concluded that doping with Al of a sphalerite containing octahedrally-bonded Cu(II) causes reduction of Cu(II) to Cu(I), and it is suggested that Cu(II) in substitutional and interstitial sites is a strong electron acceptor. The role of such electron transfer reactions in determining the structures of copper sulfides is worth more study.—ESL

03274 **Manning, P. G.** Absorption spectra of the manganese-bearing chain silicates pyroxmangite, rhodonite, bustamite and serandite: Canadian Mineralogist, v. 9, pt. 3, p. 348–357, illus., tables, 1968.

The optical absorption spectra of pyroxmangite, rhodonite and serandite show that the pink colors are due primarily to octahedrally-bonded Mn(II). The brown color of bustamite can be attributed to octahedrally-bonded Mn(II) bands superimposed on a strong background absorption. Pyroxmangite has forbidden bands in the visible region due to Fe(II) in octahedral sites. All four silicates have bands in the infrared characteristic of Fe(II) in octahedral sites, while pyroxmangite, bustamite, and serandite also show tetrahedrally-bonded Fe(II) bands.—Author's conclusion

03651 **Mansfield, J. M.; Winefordner, J. D.** Measurement of flow rate and pressure of gases in flame spectrometry: Anal. Chim. Acta, v. 40, no. 2, p. 357–359, illus., table, 1968.

A great deal of confusion exists regarding gas regulation for nebulizer-burners, especially concerning the significance of monitoring gas pressures and flow rates. Some of the major objectives in setting up a gas control system are indicated. Provision should be made for measuring pressure at the point where rate of flow is measured. A typical gas flow scheme meeting this requirement is shown. In flame stoichiometry, flow rates are meaningless without knowledge of the gas type and pressure.—ESL

Manuel, O. K. *See* Becker, V. 03804

Marcher, Melvin V. *See* Wilson, Charles W., Jr. 03712

Marcusiu, E. C. *See* Kurtz, L. T. 03259

03302 **Margoshes, Marvin; Rasberry, Stanley D.** Calibration of photographic emulsions on a digital computer—A critical test of the method [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 366, 1968.

03628 **Markowitz, William; Guinot, B.** (editors). Continental drift, secular motion of the pole, and rotation of the Earth—Internat. Astron. Union, Symposium No. 32, Stresa, Italy, 1967: Dordrecht, Holland, R. Reidel Publishing Co., and New York, Springer-Verlag, 107 p., illus., tables, 1968.

The seven scientific sessions at the symposium were concerned with: geophysical estimates of rate of continental drift, secular motion of the pole and secular changes in latitude and longitude from astronomical observations (2 sessions), polar motion from observations for time, artificial satellite techniques, theoretical papers and resolutions, and informal reports. Papers printed here have been shortened where possible, in particular, if a similar, more extensive paper has been or will be published elsewhere. Pertinent papers are cited separately.—MCM

03638 **Markowitz, William.** Concurrent astronomical observations for studying continental drift, polar motion, and the rotation of the Earth [with French abs.], *in* Continental drift, secular motion of the pole, and rotation of the Earth—Internat. Astron. Union, Symposium No. 32, Stresa, Italy, 1967: New York, Springer-Verlag, p. 25–32, illus., tables, 1968.

The analysis of 66 years of concurrent latitude observations of the ILS shows that the mean pole has a secular motion which consists of a progressive component of about 0.0035/yr(10 cm/yr) along the meridian 65° W. and a librational component (oscillation) of 24-year period along the meridian 122° W. (or 58° E.). Crustal displacements in latitude are not found within the errors of observation, about 1 cm/yr. Comparable, concurrent observations for time (longitude) have not been made but programs are being organized. From 30 to 50 years will be needed for detection of continental drift with PZT's and astrolabes if relative drifts in longitude of 3 cm/yr are occurring.—Author's abstract

03889 **Markowitz, William.** Third Symposium on Recent Crustal Movements: Am. Geophys. Union Trans., v. 49, no. 3, p. 556–557, 1968.

The Third Symposium on Recent Crustal Movements, sponsored by the International Association of Geodesy of the IUGG, was held in Leningrad, USSR, from May 22–29, 1968. Since crustal movements are very small, few new observational results since the last meeting in 1965 could be given. The chief aim of the symposium was to coordinate international research.—KAF

03936 **Marshall, Royal R.** Lead–lead age of the Bondoc meteorite: Geochim. et Cosmochim. Acta, v. 32, no. 9, p. 1013–1018, tables, 1968.

The concentration of lead in a portion of the Bondoc meteorite was determined by the isotopic dilution technique to be 0.071 ± 0.005 ppm. Isotopic ratios of the lead in the meteorite were found to be Pb–206:Pb–204 = 20.11, Pb–207:Pb–204 = 18.53, and Pb–208:Pb–204 = 39.12. The Pb–207:Pb–204 ratio is quite high relative to the Pb–206:Pb–204 ratio, indicating a possible lead–lead age of 4.94 b.y. This calculation is based on the assumption that the present U–238:U–235 ratio in this meteorite is 137.7.—Author's abstract

03519 **Martin, Dean F.** Marine chemistry—V. 1, Analytical methods: New York, Marcel Dekker, 280 p., illus., tables, 1968.

This textbook for the marine chemist has 26 chapters which discuss quantitative calculations; acids, bases, and pH of natural waters; alkalinity and total carbonate; chlorinity, salinity; dissolved oxygen content; essential micronutrients and spectroscopy; inorganic and total phosphorus; inorganic, total, and organic nitrogen; silicon; copper; manganese; iron; calcium and magnesium; atomic absorption spectroscopy; flame photometry for calcium and strontium; analysis of polluted waters; dissolved oxygen in polluted waters; biochemical oxygen demand; fluoride; and chemical properties of sediments.—VSN

Martin, R. J., 3d. *See* Brace, W. F. 03811

03597 **Martin, Robert F.** Significance of two contrasting Devonian batholithic associations from New Brunswick [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 576, 1968.

03507 **Mason, John W.** Hugoton Panhandle field, Kansas, Oklahoma and Texas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1539–1547, illus., table, 1968.

The Hugoton–Panhandle gas field, in parts of Kansas, Texas, and Oklahoma contains one of the world's largest known gas reserves. The field was discovered in 1918 by drilling on a surface structural feature and now includes almost 5.5 million acres which are being drained by 10,500 wells. Production is found in Permian and Pennsylvanian granite wash and carbonate rocks in the south and in Permian dolomite and limestone in the north. The primary controlling mechanisms for the accumulations are, in the south, a compaction anticline over the buried Amarillo ridge and, in the north, a hydrodynamic trap caused by a slight reduction in permeability at the western (updip) edge of the field. In the Kansas part production is limited both updip and downdip by water.—*from* Author's abstract

Mathews, W. H. *See* Sinclair, A. J. 03607

Matthews, R. A. *See* Geol. Soc. Sacramento. 03755

03687 **Matthews, Robert A.** Geologic hazards of Lake Tahoe Basin area, *in* Geologic studies in the Lake Tahoe area—Geol. Soc. Sacramento, Ann. Field Trip Guidebook, 1968: Sacramento, Calif., Geol. Soc. Sacramento, p. 14–26, illus., 1968.

A geologic hazard, defined as any natural catastrophic event effected by geologic causes, can easily develop in the area because of the great relief, extensive faulting, glacial scouring, with much till, and seismic activity. Descriptions of landslides, snow avalanches, earthquakes and their geologic setting are given. The Slide Mountain slide, the Emerald Bay slide, numerous snow avalanches, and the Truckee earthquake of 1966 are especially mentioned.—HRC

03329 **Mattox, Richard B.** Upheaval dome, a possible salt dome in Paradox Basin, Utah, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 215–227, illus., table, 1968.

Upheaval dome is a breached domal structure with Permian to Jurassic rocks exposed. About 3,000 feet of Pennsylvanian salt underlies the area of the dome. The following hypotheses of origin have been advanced: (1) a cryptovolcanic feature, (2) a simple salt dome, (3) meteorite impact, (4) unloading of overburden by stream erosion causing upward salt movement, and (5) a dome produced by multiple salt movements from local diastrophism or igneous intrusion. The writer suggests that the dome is a product of salt flowage resulting from differential pressures, produced by differential compaction ove the flanks of a buried hill, or monadnock, on the Precambrian basement comple .. —*from* Author's abstract

03715 **McAlester, A. Lee.** Type species of Paleozoic nuculoid bivalve genera: Geol. Soc. America Mem. 105, 143 p., illus., tables, 1968.

This study provides redescriptions and modern illustrations of the type species for all Paleozoic nuculoid bivalve genera, which make up about ten percent of the generic names proposed for Paleozoic bivalves. Sixty-four names are included, of which eight are nomenclaturally invalid, leaving 56 valid names. Original type species were located and redescribed for 39 of the 56. Topotypes or other conspecific specimens were used for ten more, and the remaining seven, mostly rare Asiatic genera, were redescribed from the original descriptions. Four type species are designated, and lectotypes selected for 19 genera. Subjective considerations are omitted to provide a foundation of facts for future evolutionary studies.—*from* Author's abstract

McBirney, Alexander. *See* Gomberg, David N. 03853

03730 **McCaleb, James A.** Lower Pennsylvanian ammonoids from the Bloyd Formation of Arkansas and Oklahoma: Geol. Soc. America Spec. Paper 96, 123 p., illus., tables, 1968.

Approximately 8,000 well-preserved ammonoids from the Lower Pennsylvanian Bloyd Formation from the type area of the Morrowan in Washington County, Ark., and from stratigraphic equivalents elsewhere in northern Arkansas and Oklahoma have been studied. Representatives of the genera *Proshumardites, Syngastrioceras, Pygmaeoceras, Pseudoparalegoceras, Retites, Branneroceras, Diaboloceras, Axinolobus, Cymoceras,* and *Pronorites* are reviewed systematically. New species of *Bisatoceras, Wiedeyoceras,* and *Gastrioceras* are described. On the basis of ammonoid sequences in the type Bloyd Formation,numerous occurrences in Arkansas and Oklahoma can be assigned stratigraphically, and correlation can be made with the Namurian-Westphalian and Bashkirian-Moscovian sections of Eurasia.—*from* Author's abstract

03255 **McCave, I. N.** Shallow and marginal marine sediments associated with the Catskill complex in the Middle Devonian of New York, *in* Late Paleozoic and Mesozoic continental sedimentation, northeastern North America—A symposium: Geol. Soc. America Spec. Paper 106, p. 75–107, illus., 1968.

The Portland Point Member of the Moscow Formation has been used as a time plane for correlation and environmental interpretation of strata 100 feet above and 150 feet below it. Recognized from east to west are: alluvial plain; marginal marine tidal flats, distributary channels, and interdistributary areas; nearshore shallow marine area; and offshore sandy and silty shelf. One small deltaic lobe is recognized. Strike lines perpendicular to paleocurrent vectors for the Middle Devonian of eastern New York show an undulatory surface, interpreted as small lobate deltaic developments down the Catskill shoreline. Shelf-indicated paleocurrent directions are thought to have been tidal in origin; sand-silt relations were controlled by a paleoslope southwestward from the Adirondack high, and by depth changes associated with the Portland Point transgression.—*from* Author's abstract

03777 **McConnell, Phillip C.** Frank B. Carter (1898–1968): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 7, p. 1304–1305, portrait, 1968.

McCourt, G. B. *See* Prather, R. W. 03334

03469 **McCrae, R. O.; Swenson, R. E.** Geology and natural gas occurrence, western Williston basin, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1288–1303, illus., table, 1968.

In the western Williston basin in a sedimentary section averaging 10,000 neet, about one-third of the lower half (or Paleozoic) is composed of evaporites and carbonates; the balance is shale and sandstone. All commercial gas in Paleozoic rocks is in solution in oil; that in Mesozoic rocks is nonassociated. Trapping is partly related to folding, but also is at the extreme seaward limits of sandstone tongues. Porosity of less than 10 percent and low permeability are characteristic; fracturing is important in improving overall permeability. At Cedar Creek anticline 6 million cu ft a day of 90 percent nitrogen gas was treated in a Cambrian sandstone. Shallower beds contain some nitrogen both as free accumulations and associated with oil. Evidence suggests a basement-rock source for nitrogen.—*from* Authors' abstract

03561 **McCrone, Alistair W.; Koch, Robert C.** Natural and experimental sodium uptake in Hudson River sediments, Kingston to Manhattan, New York: Jour. Sed. Petrology, v. 38, no. 2, p. 655–660, illus., tables, 1968.

Natural bottom sediment samples, including those with a fairly high cation exchange capacity, from both the fresh and estuarine parts of the Hudson River contained comparably small quantities of exchangeable sodium (average 2.2 milliequivalents per 100 grams). When natural fresh water muds were artificially mixed with increasing increments of sea water, the muds were able to absorb a maximum of only 0.8 millequivalents of exchangeable sodium at salinities up to 5 per mille. At salinities above 5 per mille even up to 30 per mille (open sea water), the muds accepted no more than 1.45 millequivalents.—Authors' abstract

03772 **McDaniel, Gary A.** Application of sedimentary directional features and scalar properties to hydrocarbon exploration: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1689–1699, illus., tables, 1968.

Ripple marks, cross bedding, and groove casts are examples of directional features of sediments. Systematic downcurrent variations in grain size or mineral composition are examples of scalar properties. Directional features and scalar properties of sediments are used to determine paleocurrent direction. The integration of paleocurrent data with environmental information yields a paleogeographic map, from which prediction of favorable areas for wildcat exploration and the exploitation of wildcat discoveries can be made. [A study of the Hartshorn Formation, Arkoma Basin, Okla., is cited as an example.]—*from* Author's abstract

03768 **McDonald, Barrie C.** Composition of some garnets used in provenance studies of tills: Jour. Sed. Petrology, v. 38, no. 3, p. 956–957, table, 1968.

Objective and detailed data are necessary for application of garnet-ratio studies to till provenance. The garnets in common use differ significantly in cell dimension.—Author's abstract

03863 **McKelvey, Gregory E.** Depositional environment of middle carbonate units of Belt Supergroup, Montana and Idaho: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 858–864, illus., table, 1968.

The Wallace Formation and its stratigraphic equivalents of the late Precambrian Belt Supergroup in Montana and Idaho were deposited in an elongate northwest-trending basin. The axis of maximum accumulation coincides approximately with the center line of the basin, and the thickness decreases symmetrically away from it; the maximum thickness is 16,500 feet, near Libby, Mont. Limestone and dolomite are the principal rocks on the eastern side of the basin and are characterized by the presence of oolites, stromatolites, and mud-chip breccia. Clastic rocks with minor carbonate constituents make up most of the section in the center and on

the western side of the basin. Graded bedding, crossbedding, channel structures, and ripple marks are the typical sedimentary structures in the clastic section. Mud cracks are present throughout the area but are most common in the lower part of the section.—Author's abstract

03671 **McKelvey, V. E.** Mineral potential of the submerged parts of the U.S.: Ocean Industry, v. 3, no. 9, p. 37–43, illus., tables, 1968.

Mineral resources are evaluated for the continental shelf bordering the U.S. (including Alaska and Hawaii), extending approximately to the 2,500-meter isobath—an area of about 1,284,000 sq mi. Resource estimates are classified by degree of certainty and by feasibility of recovery and sale for: petroleum; sulfur, salt, potash, and geothermal energy; phosphorite; manganese nodules; placer minerals; large (>100 million dollars) undiscovered bedrock deposits of metals and other hard minerals. Petroleum has enormous present and prospective value; sulfur also is economically recoverable. Submerged beach placers off Nome, Alaska, may be gold bearing. Phosphorite and gravel may have local markets. The large potential resources of other minerals either cannot be appraised or cannot be extracted economically at present.—VMJ

03917 **McKenzie, D. P.** The influence of the boundary conditions and rotation on convection in the Earth's mantle: Royal Astron. Soc. Geophys. Jour., v. 15, no. 5, p. 457–500, illus., 1968.

The external nonhydrostatic gravity field must be maintained by flow within the mantle. An analysis of axisymmetric poloidal circulation in a rotating compressible sphere shows it to be more important than was previously believed. The conditions which must be satisfied before this approximation is valid are examined in some detail because of their relevance to convection in the mantle. The horizontal temperature differences between oceans and continents must also drive convection currents. Two-dimensional convection driven by horizontal temperature variations can successfully account for most of the phenomena which are believed to be the surface expressions of flow in the mantle. The only exception is the gravity anomaly over the rising current, which is positive in the model. This linear theory is not self consistent but it shows that convection of heat is the only important nonlinear term.—*from* Author's abstract

McKenzie, William F. *See* Trusell, Fred C. 03650

McMahon, B. E. *See* Strangway, D. W. 03916

McMurtrey, R. G. *See* Konizeski, R. L. 03625

03884 **McMurtry, Wilbur E.; Owen, Edgar W.** Everett Carpenter—Historical notes: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1800–1803, 1968.

The general aspect of petroleum geology in the early part of the 20th century in the United States is reviewed to illustrate the important role played by Everett Carpenter in the profession.—VSN

Meents, W. F. *See* Bond, D. C. 03491

03492 **Meents, W. F.** Illinois glacial-drift gas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1754–1758, illus., tables, 1968.

Gas is produced from 62 areas in 27 counties in the northeastern part of Illinois. It originates in the Sangamon Soil and the Sankoty Sand, most being from the former. Gas is especially common where end moraines lie over Sangamon Soil-filled valleys. Much of the gas originates in buried peat and organic-rich silt overlying weathered interglacial strata, especially that of the Sangamon Interglacial. The peat is considered part of the soil zone in these studies. Gas from the Sankoty Sand comes either from decaying plant material in the sand or from the underlying Pennsylvanian coal formations. The accumulation of glacial-drift gas in a particular

area is controlled mainly by the character and thickness of the glacial drift above the gas zone. Analyses are included.—HRC

Melsom, Sigurd. *See* Högdahl, Ove T. 03681

03924 **Menard, H. W.; Atwater, Tanya.** Changes in direction of sea floor spreading: Nature, v. 219, no. 5153, p. 463–467, illus., 1968.

Magnetic anomalies and fracture zones make distinctive patterns when the direction of sea-floor spreading changes, as has occurred repeatedly in the northeastern Pacific. The mode of deformation is such that the spreading centers between transform faults become uniformly reoriented essentially perpendicular to the fault. The principal variables influencing the tectonic effects of a change in direction of sea-floor spreading are the geometry of the mid-ocean ridge crest, the spacing of transform faults, and the amount and rate of change.—KAF

03727 **Menzies, Robert J.; Rowe, Gilbert T.; Atkinson, Larry P.** A small basin containing anoxic sediments—Lookout Bight, North Carolina: Internat. Rev. Gesamten Hydrobiologie, v. 53, no. 1, p. 77–81, illus., table, 1968.

Biological samples were collected at three-ft depth intervals along three transects. Core samples were also taken at each position, and size frequency analyses were run on the muds. In addition, grab samples were taken around the basin to delimit the area of anoxic sediments, 60,000 sq yds, with a depth maximum of 33 feet. Sediment in this area is devoid of macrobenthic fauna. The salinity profile indicates that the water column was steady. Water near the bottom was 50 percent saturated with oxygen in August, and 10 percent in September and May. Phosphate, nitrate, and silicate concentrations were higher in the bottom water. The basin is believed to have formed between 1852 and 1962, due to current changes following the opening of Barden Inlet. The main water source is from the ocean, with Core Sound giving the Bight its small source of land drainage.—ESL

03471 **Merriam, Daniel F.; Goebel, Edwin D.** Natural gas in Kansas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1548–1557, illus., tables, 1968.

Kansas gas production has been 11.4 trillion cu ft since commercial discovery in 1873, most from the Hugoton field in the southwestern part of the state. Kansas reserves are estimated to be 17.4 trillion cu ft. Permian rocks have yielded 74 percent of the gas; Pennsylvanian, 15 percent; Mississippian, 9 percent; and the other 2 percent from lower Paleozoic rocks. Cumulative production from major structural features is: Hugoton embayment, 76 percent; Cherokee basin, 8 percent; Sedgwick basin, 8 percent; Central Kansas Uplift, less than 3 percent; Pratt anticline, less than 2 percent; and the Forest City basin, Nemaha anticline, and Salina basin, less than 1 percent each. Helium, natural gas liquids, and carbon-black are important byproducts.—*from* Authors' abstract

03441 **Meyerhoff, A. A.; Hatten, C. W.** Diapiric structures in central Cuba, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 315–357, illus., 1968.

Four evaporite diapirs in Matanzas and Camagüey Provinces are localized by major faults. Two diapirs penetrate Jurassic eugeosynclinal rocks at or near the surface, as they contain exotic blocks of the host rock and other, older rocks. During tectonism, miogeosynclinal carbonates were detached from underlying evaporites, crushed, and overridden by eugeosynclinal rocks. After Eocene time, the evaporites intruded the miogeosynclinal and eugeosynclinal rocks along major faults; the latest diapiric movements were post-Miocene. The small number of diapirs is related probably to the great competence of the thick, overlying post-evaporite section.—HRC

03941 **Meyerhoff, A. A.** Arthur Holmes—Originator of spreading ocean floor hypothesis: Jour. Geophys. Research, v. 73, no. 20, p. 6563–6565, illus., 1968.

Arthur Holmes first published the hypothesis of the spreading ocean floor in 1931, a fact not generally realized. In addition, many other well-known hypotheses antedate publication by their "inventors" by periods of time ranging from several years to more than 100 years.—Author's abstract

03528 **Michigan Geological Survey.** Michigan's oil and gas fields, 1967: Michigan Geol. Survey Ann. Statistical Summ. 8, 72 p., illus., tables, 1968.

Part 1 contains information on drilling permits, well completions, production, etc. Part 2 is a compilation of material on oil and gas fields, maps, gas storage reservoirs and related items. Part 3 contains cumulative statistics principally of oil and gas production, well completions, and oil-field brine production and disposal from 1925 through the most recent year-end compilations.—MCM

03598 **Migues, Richard.** Petrology of rodingites in ultramafites, Klamath Mountains, California [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 576, 1968.

03632 **Mikesh, David L.; Glenister, Brian F.** *Solenochilus springeri* (White and St. John, 1868) from the Pennsylvanian of southern Iowa: Iowa Acad. Sci. Proc. 1966, v. 73, p. 269–278, illus., 1968.

The unique Pennsylvanian nautilid *Solenochilus springeri* is described with reference to material from the lower Cherokee Group (Atokan or Desmoinesian) of Marion County, Iowa, and the Bloyd Formation (Morrowan) of northwestern Arkansas. The species was based originally on a specimen, now lost, from Adair County, Iowa; a neotype is selected from the Marion County collections. The detailed morphology of the pair of dorsolateral spines which characterize mature *Solenochilus* is described for the first time. These spines, whose length approximates the width of the mature body chamber, are hollow throughout. Each spine originated as a lateral expansion of a prominent dorsolateral ridge located on the umbilical shoulder.—Authors' abstract

03904 **Milici, Robert C.** Mesozoic and Cenozoic physiographic development of the lower Tennessee River—In terms of the dynamic equilibrium concept: Jour. Geology, v. 76, no. 4, p. 472–479, illus., 1968.

The northwesterly trend of the Tennessee River across the Appalachian Mountains is regarded as initiated by consequent drainage down a coastal plain of Pennsylvanian sediment rocks. Downdip lateral migration resulted in curvature around the Nashville dome. By the time of late Cretaceous inundation, precursors of major topographic features had already formed. The downvalley, north-trending segment resulted from the river following "consequent lows" on the emerging Cenozoic coastal plain or from capture by drainage tributary to the Ohio River.—DRM

03472 **Miller, Robert R.** Geology of Otis-Albert field, Rush and Barton Counties, Kansas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1588–1615, illus., tables, 1968.

The "Basal" (Reagan?) sandstone and dolomite of the Arbuckle Group are the two productive units in the field. Both gas and oil are produced from the "Basal" sandstone; the Arbuckle is productive of only oil. The trap responsible for oil and gas in the sandstone is referred to as a secondary stratigraphic trap. The basal Pennsylvanian conglomerate oversteps the truncated Arbuckle dolomite, the "Basal" sandstone, and the Precambrian crystallines, and forms the cap rock for the "Basal" sandstone reservoir; the "Basal" pinches out updip against the Precambrian.—*from* Author's abstract

Millhollen, Gary L. *See* Holloway, John R. 03831

03296 **Mitchell, Betty J.** Unusual background and matrix effects in X-ray spectroscopy [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 363, 1968.

03741 **Mizoue, Megumi.** Earthquake magnitude determination in relation to regional variations of P-wave amplitudes, Pt. 1 [with Japanese abs.]: Tokyo Univ. Earthquake Research Inst. Bull., v. 46, pt. 3, p. 457–484, illus., tables, 1968.

Body wave magnitude m_{pz} reported by the USCGS for earthquakes with shallow focus determined at near and regional epicentral distances deviates significantly from the magnitude of the same events determined at teleseismic distances. Overestimation of magnitude by 0.5 to 1.5 magnitude units in epicentral distance between 5° and 13° relative to magnitude at teleseismic distances shows that the zone of low amplitude signals predicted by Gutenberg and Richter (1956) in that distance range does not exist as a worldwide phenomenon. Regional correction factors as a function of epicentral distance subtractive from the calibrating function $Q(\Delta)$ are calculated for the five reference stations: College, Alaska; Tonto Forest, Arizona; Caracas, Venezuela; Port Moresby, New Guinea; and Rabaul, New Britain.—*from* Author's abstract

Moberly, Ralph, Jr. *See* Malahoff, Alexander. 03813

03599 **Montgomery, J. H.** Petrology of the Copper Mountain intrusions near Princeton, B. C. [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 577, 1968.

03321 **Moore, B. J.; Walter, F. J.** Recent developments in semiconductor X-ray spectrometers and their implications to X-ray analyses [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 378, 1968.

03793 **Moore, David G.; Buffington, Edwin C.** Transform faulting and growth of the Gulf of California since the late Pliocene: Science, v. 161, no. 3847, p. 1238–1241, illus., 1968.

Seismic-reflection and magnetic profiles over more than 6,000 km suggest that spreading of the sea floor on the East Pacific Rise, at the mouth of the Gulf of California, began to broaden a proto-gulf about 4 m.y. ago. Movement occurred, on transform faults, offsetting the rise and other centers of crustal growth within the Gulf, and translated the end of the peninsula about 200 km to the northwest. Thick pelagic sediments on the east flank of the rise indicate that there was a lapse of spreading by crustal growth between 4 and 10 m.y. ago.—Authors' abstract

03328 **Morgan, James P.; Coleman, James M.; Gagliano, S. M.** Mudlumps—Diapiric structures in Mississippi delta sediments, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 145–161, illus., 1968.

The stratigraphy and structure of mudlumps at the mouth of South Pass of the Mississippi River are studied in drill cores. A relationship is established between the older shelf and prodeltaic river deposits and younger, progradational delta-front and river-mouth bar sediments. The mudlumps are near-surface expressions of the diapiric intrusion of older shelf and prodelta clays into and through overlying bar deposits, culminating in reverse faulting with a vertical displacement of the older clay by as much as 350–400 feet. Between the diapiric clay masses are synclinal troughs filled with as much as 400 feet of rapidly-accumulated, near-strandline bar sand, silt, clay, and organic deposits. Rapid deposition of thick bar sediments directly on the lighter plastic clay leads to instability which is relieved by diapiric intrusion of the clay.—*from* Authors' abstract

03771 **Morley, L. W.; MacLaren, A. S.; Charbonneau, B. W.** Magnetic anomaly map of Canada: Canada Geol. Survey Map 1255A, scale 1:5,000,000, text, 1968.

This map is derived from approximately 3,400 standard total field aeromagnetic maps published at a scale of 1 in. to 1 mi. Its most striking characteristic is the manner in which the boundaries between the various geological provinces are evident. There are, however, several major magnetic features several hundreds of miles in extent which, as yet, have no geological explanation. The map can be regarded as mainly reflecting the major deeper-seated effects. Broad magnetic 'low' areas coincide well with regions of predominantly sedimentary and volcanic rocks and their gneissic equivalents, magnetically 'high' areas with more extensively granitized terrain. The map will assist in interpreting regional geological structure

in the basement rocks both where they are exposed and where they are overlain by cover rocks.—MCM

Morris, Donald A. *See* Waller, Roger M. 03694

Morrison, H. F. *See* Bodmer, René. 03814

03624 **Morrissey, C. J.** Mineral specimens: New York, American Elsevier Publishing Co., 202 p., illus., 1968.

The purpose of the book is to indicate pictorially the splendid diversity of color and form displayed by minerals, and to provide information about the chemistry, structure, characteristic properties, and uses of the species illustrated, primarily as a reference book for use by the amateur mineralogist. The plates show minerals in their most recognizable form, generally as crystals or as homogenous masses. A glossary of terms used is appended.—MCM

Mossotti, V. G. *See* Golightly, D. W. 03289

Mountjoy, E. W. *See* Macintyre, I. G. 03562

03466 **Muehlberger, William R.; Clabaugh, Patricia S.** Internal structure and petrofabrics of Gulf Coast salt domes, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 90–98, illus., 1968.

Internal structures and preferred orientation of halite crystals in Grand Saline salt dome, Texas, and Winnfield salt dome, Louisiana, indicate emplacement of the stocks by successive differential movements of spines and lobes. Differences in intensity of shear folding and varied degrees of preferred orientation in these and other Gulf Coast salt domes suggest that mines within the domes are at different structural levels and that movement of the salt has, in some cases, been very complex. Study of the preferred orientation of bedded salt from Oklahoma showed that it increases with depth.—Authors' abstract

03652 **Mukherji, Anil K.** Determination of calcium and oxalate with an ion-exchange electrode: Anal. Chim. Acta, v. 40, no. 2, p. 354–356, illus., table, 1968.

The recently introduced calcium activity electrode for the complexiметric determination of calcium and zinc ions detects the ions just as a glass electrode detects hydrogen.—ESL

03275 **Mulligan, R.; Jambor, J. L.** Tin-bearing silicates from skarn in the Cassiar District, northern British Columbia: Canadian Mineralogist, v. 9, pt. 3, p. 358–370, illus., tables, 1968.

Two skarns in the Cassiar District of northern British Columbia are characterized by the presence of up to 0.9 percent SnO_2 in a unique iron-rich silicate assemblage of andradite, epidote, ferroactinolite, and hedenbergite. No normal tin minerals are present, and indications are that tin is principally in the lattice of garnet and epidote, probably as Sn^{4+} substituting for Fe^{3+}.—Authors' abstract

03467 **Murray, Grover E.** Salt structures of Gulf of Mexico basin—A review, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 99–121, illus., 1968.

Over 300 diapiric structures are known in and around the Gulf of Mexico; they are rod-like, domal, anticlinal, and ridge-like, and all rise vertically, or nearly so, and increase or decrease with height. Many are capped by residual anhydrite which may be altered to other material. They may have grown by upward movement of the salt through overlying sediments in response to gravitational inequilibrium, or by the salt structures remaining essentially stable with the sediments moving downward around them. Variations in overburden and faulting are the chief causes of the start of movement. The Louann salt is probably the main source of Gulf coast diapirs; it may have been originally over 5,000 feet thick and with original

volume of 20,000 cu mi. Surrounding sediments have varied structural configurations.—HRC

03600 **Mursky, Gregory.** Geochemical patterns and their economic significance in the north-central District of Mackenzie, N.W.T. [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 577–578, 1968.

03442 **Musgrave, A. W.; Hicks, W. G.** Outlining shale masses by geophysical methods, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 122–136, illus., 1968.

"Shale masses", as used herein, refer to large bodies of shale at least several hundred feet thick; they may be diapiric or depositional. Shale masses act like salt; they have four properties: (1) low-velocity sound transmission, (2) low density, (3) low resistivity, and (4) high fluid pressure. Maps and cross sections from Ship Shoal area, Louisiana, are used as examples. These physical properties allow outlining the body by various geophysical techniques. Gravity is used to outline low-density material, seismic reflection is used to outline lack of reflection contrast and to map velocity configuration, and seismic refraction is used to outline velocity within the anomalous mass, thereby differentiating between shale and salt.—*from* Authors' abstract

03245 **Mutch, Thomas A.** Pennsylvanian nonmarine sediments of the Narragansett Basin, Massachusetts-Rhode Island, *in* Late Paleozoic and Mesozoic continental sedimentation, northeastern North America—A symposium: Geol. Soc. America Spec. Paper 106, p. 177–209, illus., table, 1968.

These clastics, estimated to be 12,000 feet thick, are mostly alluvial. North and west, the Pondville Conglomerate unconformably overlies older igneous and metamorphic rocks. Eastern basal Pennsylvanian arkoses, highly altered, grade down into weathered granite. Above is the Rhode Island Formation, thick sandstone with many beds of conglomerate and siltstone, granitic detritus from the west. Rocks in the southeast had a quartzitic source to the east. The reddish Wamsutta Formation, interfingering the Rhode Island on the northwest, is poorly sorted with felsite debris, and may include subaerial mudflows. At top is the Dighton Conglomerate. Radiometric ages suggest that basin deposition, florally dated as Pennsylvanian, continued into the Permian. Composition of the conglomerates contrasts with that of vein quartz-pebble conglomerates along western front of the Appalachians.—GDC

03308 **Myers, Alfred T.; Havens, Raymond G.** Spectrochemistry applied to geology and geochemistry in the Rocky Mountain region [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 368, 1968.

03479 **Myers, John C.** Sulfur—Its occurrence, production, and economics, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1948–1956, illus., table, 1968.

Sulfur is produced as elemental sulfur from the cap rock overlying salt domes, from sedimentary and volcanic deposits, and from hydrogen sulfide in sour-gas and sour-oil fields. It is produced as sulfur compounds from pyrite,pyrrhotite, and marcasite ores, and as sulfur dioxide gas in the smelting of sulfide ores. Salt domes are present in Texas and Louisiana along the north shore of the Gulf of Mexico, and on the Isthmus of Tehuantepec along the south shore of the Gulf of Mexico. The recovered sulfur—also classed as elemental—is produced with gas along the Foothills belt at the eastern edge of the Rocky Mountains, from northern Canada southward to and including the Permian basin of Texas and New Mexico, and along the south side of the Ouachita folded belt of Texas, Arkansas, and Mississippi. Iron sulfide ores also are found in numerous places.—*from* Author's abstract

03846 **Nackowski, M. P.; Proctor, P. D.** Use of geological engineering methods continues to grow: Mining Eng., v. 20, no. 2, p. 73–76, illus., 1968.

Quantification in recording geologic phenomena and application of well-known geologic principles to engineering works continued at an increasing rate during 1967.

Engineering geology is currently being used in tunnel excavations, dam site locations and construction, subsurface liquid-waste disposal, designing of underground storage facilities, urban and regional planning, highway design, and water resource studies. Environmental geology and the study of geologic hazards are becoming increasingly important. Unusual applications of seismic networks, remote sensing methods, and X-ray techniques in geological engineering added other tools to this increasingly important profession.—MAC

03795 **Naidu, Prabakar S.** An example of linear filtering in aeromagnetic interpretation: Geophysics, v. 33, no. 4, p. 602–612, illus., 1968.

An anomaly east of Great Slave Lake in northern Canada was selected to test the applicability of linear filtering to aeromagnetic data. Since the anomaly is linear, we have considered two parallel but widely separated profiles across the anomaly. The aeromagnetic anomaly observed along these profiles was filtered using Strakhov's filter operator. The filtered signal was matched with the computed field of a dike model with an average susceptibility in the range 1.7 to 2.7×10^{-3} cgs units. Furthermore, from the suppressed noise component, an estimate of the variance of the random magnetization has been made. The estimated variance is in the range 0.61 to 0.5×10^{-6} cgs units. Although there is no available geological information about the value of these parameters, the calculated values seem to be reasonable.—Author's abstract

03601 **Naldrett, A. J.; Rucklidge, J. C.** Electron microprobe studies of minerals across a section of the Sudbury Nickel Irruptive [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 578, 1968.

03304 **Nash, D. L** Spectrographic analysis of small areas using a sapphire mask and spark excitation [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 366, 1968.

Naughton, J. J. *See* Noble, C. S. 03838

Newell, Norman D. *See* Boyd, Donald W. 03876

Nickel, E. H. *See* Faye, G. H. 03767

03260 **Nickel, Ernest H.** Structural stability of minerals with the pyrite, marcasite, arsenopyrite and löllingite structures: Canadian Mineralogist, v. 9, pt. 3, p. 311-321, illus., tables, 1968.

Structural stabilities of disulfides, diarsenides and sulfarsenides of iron, cobalt and nickel are explained on the basis of ligand field theory, and can be correlated with the number of nonbonding *d* electrons of the metal atom in the structure, and explained by the tendency of compounds to form structures in which maximum electron spin-pairing takes place. Minerals with pyrite structure are characterized by metal-sulfur octahedra joined at corners, with no apparent interaction between *d* electrons of neighboring metal atoms. Other structures are characterized by shared octahedral edges along one direction, so that metal atoms are brought into close proximity. In minerals with marcasite structure, there is sharing of octahedral edges, but subtending angles are less than 90°, indicating metal-metal repulsion. In löllingite the large subtending angle and short intermetallic distance signify interaction between adjoining metal atoms.—ESL

03602 **Nickel, Ernest H.** Crystal chemistry of the skutterudite minerals [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 578–579, 1968.

03838 **Noble, C. S.; Naughton, J. J.** Deep-ocean basalts—Inert gas content and uncertainties in age dating: Science, v. 162, no. 3850, p. 265–267, table, 1968.

The radiogenic Ar and He contents of three basalts erupted into the deep ocean from an active volcano (Kilauea) have been measured. Ages calculated from these measurements increase with sample depth up to 22 m.y. for lavas deduced to be recent. Caution is urged in applying dates from deep-ocean basalts in studies on ocean-floor spreading.—Authors' abstract

03725 **Norford, B. S.** A Middle Cambrian *Plagiura–Poliella* faunule from southwest District of Mackenzie, *in* Contributions to Canadian palaeontology: Canada Geol. Survey Bull. 163, p. 29–38, illus., 1968.

A lower Middle Cambrian faunule is described from unnamed beds near the South Nahanni River, District of Mackenzie. The faunule indicates the *Plagiura–Poliella* Zone. Rocks of similar age include the Mount Whyte Formation of southwest Alberta and possibly part of the Cape Kent Formation of northwest Greenland. Two new trilobite species are proposed, *Fieldaspis(?) nahanniensis* and *Kochiella mackenziensis*.—Author's abstract

Norris, G. *See* Hedlund, R. W. 03747

Nyman, Dale J. *See* Bell, Edwin A. 03691

03330 **Oakeshott, Gordon B.** Diapiric structures in Diablo Range, California, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 228–243, illus., 1968.

The Jurassic through Tertiary sedimentary rocks flanking the Diablo Range are 39,000 feet thick. Franciscan sediments and volcanic material were deposited on a simatic basement consisting of upper mantle ultramafic rocks overlain by oceanic serpentine. These were thrust under the margin of the continent. The low-density sediments and ultrabasic magma intrusions initiated folding and serpentinization. The serpentine, with low bulk density, plasticity, lubricating qualities, and extreme mobility, was subject to upward movement and piercement. Succeeding orogenic movement and erosion resulted in upward, diapiric movement of the serpentine. The culmination of the piercement took place in the Pliocene and has continued to the present.—HRC

03538 **O'Brien, Dennis C.** Cubic casts as indicators of "top and bottom" in the Shields Formation (Precambrian Belt Supergroup): Jour. Sed. Petrology, v. 38, no. 2, p. 685–687, illus., 1968.

Cubic salt casts are commonly observed in the Missoula Group (Precambrian Belt Supergroup) in northwestern Montana. This structure has been used as an environmental indicator and as a criterion of stratigraphic correlation. Salt casts are especially abundant in the Shields Formation, where field observations in the southern Lewis and Clark Range indicate that they occur exclusively on the bottoms of strata. Salt casts are reliable indicators of "top and bottom" in this area and may be useful for that purpose in other areas of Shields exposure.—Author's abstract

O'Brien, G. D. *See* Braunstein, Jules. 03331

03461 **O'Brien, G. D.** Survey of diapirs and diapirism, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 1–9, illus., table, 1968.

The words come from the Greek diapeirein, meaning "to pierce". Diapirs *sensu stricto* are composed of evaporites, argillaceous sediments, coal, peat, ice, serpentine, or other materials having low equivalent viscosity and low density. The materials range in age from Precambrian to Recent. They are found everywhere except in shield areas and have many forms, ranging from smoothly rounded pillows to completely injected laminae, and occur at the surface or at considerable depths. Diapirs have internal structures indicative of a flow origin. Surrounding strata may or may not be affected. They develop by horizontal compression, gravitational instability, or both. Diapiric structures may contain oil, gas, sulfur, salt, and potash and are important for underground storage and nuclear testing.—*from* Author's abstract

O'Brien, Gerald D. *See* Braunstein, Jules. 03468

03929 **O'Connell, Richard J.** Critique of the paper by W. J. van de Lindt, "Movement of the Mohorovicic discontinuity under isostatic conditions" [1967]: Jour. Geophys. Research, v. 73, no. 20, p. 6604–6607, illus., 1968.

The letter points out some shortcomings of van de Lindt's investigation and conclusions (ibid., v. 72, p. 1289–1297, 1967), namely: a serious inconsistency in one of his models that makes its physical reasonableness doubtful; a possible error in the expression for the velocity of the moving phase boundary; the conclusion that the latent heat and Clapeyron slope of the phase change have little influence on the solution, which is not true in general; and an error in the part of the discussion concerning fast sedimentation and stability.—DBV

03464 **Odé, Helmer.** Review of mechanical properties of salt relating to salt-dome genesis, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 53–78, illus., tables, 1968.

The ability of salt to flow or creep slowly under sufficient differential pressure is of particular importance in explaining the formation and shape of salt structures. The time-dependent strain or creep on salt and other nonmetallic substances is not well understood, but available data show that, under suitable conditions of pressure, temperature, and environment, salt and other nonmetallic materials show a behavior similar to that of metals. Data concerning creep of salt obtained in the laboratory and *in situ* have been studied. From these data it is possible to derive, for the given conditions of stress, temperature, and environment, an equivalent viscosity for the salt. The values obtained show a variation of many orders of magnitude.—*from* Author's abstract

Offield, Terry W. *See* Howard, Keith A. 03840

Opdyke, Neil D. *See* Knowles, Raymond R. 03938

03673 **Overall, M. P.** Mining phosphorite from the sea—Pt. 1, Market structure and geology: Ocean Industry, v. 3, no. 9, p. 44–48, illus., table, 1968.

Market structure and outlook of the U.S. phosphate industry are analyzed. Although world demand for phosphate is ever increasing, and known and projected occurrences of offshore phosphorite are widespread, there are many deterrents to exploration programs. Offshore exploration is costly, especially in very deep water, where the most attractive phosphorite deposits can be expected. Exploration tools and procedures are not yet sufficiently developed to guarantee accurate evaluation of samples. Exploration money can be more profitably spent on discovery of land deposits, most of which also have higher P_2O_5 content. The Forty-Mile Bank off San Diego, Calif., and the Santo Domingo Bay deposit off Baja California, Mexico, are the only two areas where sampling has been extensive enough to justify offshore mining.—VMJ

Owen, Edgar W. *See* McMurtry, Wilbur E. 03884

Owens, W. H. *See* Hamilton, N. 03903

Ozias, Karen. *See* Anderson, Wayne I. 03631

03440 **Paine, William R.** Recent peat diapirs in the Netherlands—A comparison with Gulf Coast salt structures, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 271–274, illus., 1968.

Peat diapirs, 3–4 feet high, are found in Recent sediments of Flevoland overlying an eroded Pleistocene surface. Small-scale diapiric folds and related structures, similar to the larger Gulf Coast structures, are present in the Recent deposits on the flanks of several elongate Pleistocene sand ridges. There are down-to-the-basin normal faults, rim synclines, and, in one place, a central graben. The diapiric folds are found where the dip of the onlapping Recent sediments increases along the flanks of the sand ridges. The folds probably resulted from the flow of the peat down the ridge slopes, 1,000 to 1,500 yr B.P.—*from* Author's abstract

03754 **Panoš, Vladimír; Štelcl, Otakar.** Physiographic and geologic control in development of Cuban mogotes [with German and French abs.]: Zeitschr. Geomorphologie, new ser., v. 12, no. 2, p. 117–163, illus., 1968; reply to discussions, ibid., p. 168, 1968.

Investigations show that the isolated limestone hills (mogotes) are polygenetic forms. Basic characteristics are described and discussed for genetic types. They occur in continuous limestone massifs in: warped limestone, alluvial, and flooded limestone plains; limestone marine terraces; dissected dome units, the axial portions, cuesta back slopes and face edges, and rejuvenated leveled surfaces; and uplifted and tilted plateaus. They are built of interrupted limestone strata when linked with strata interrupted by tectonics; with diapiric structures; or strata interrupted by exogene agents, as relics of leveled folded structures, residual hills on an exposed batholith, and in dissected alluvial plains. Calcareous crusts covering bare limestone surfaces are discussed also. A map showing karst types, and geomorphologic maps of the eastern Madruga–Limonar Highlands and western Sierra de los Organos Mts. are included.—ESL

Parissis, C. M. *See* VanLoon, J. C. 03648

03880 **Parker, Everett C.** James Ira Daniels (1896–1967): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1803–1804, portrait, 1968.

Parker, J. W. *See* Picard, M. Dane. 03512

03514 **Parker, John M.** Lisbon field area, San Juan County, Utah, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1371–1388, illus., tables, 1968.

The Lisbon field oil and gas accumulation is trapped in a faulted anticline. Reservoirs are in five zones—the McCracken and Ouray of Devonian age, the Leadville of Mississippian age, and the middle Paradox and Honaker Trail (upper Hermosa) of Pennsylvanian age. Only the Mississippian oil, condensate, and gas reservoir is of commercial importance at the present time. Oil production from the Mississippian from 1960 to September 1965 was 11,801,530 bbl. Remaining oil reserve is estimated to be 39 million bbls. Gas reserve is estimated to be 240 billion cu ft. The gas now being produced is injected into the Mississippian in a pressure-maintenance program. It is estimated that gas sales will begin in 1973. The gas has a high nitrogen and carbon dioxide content (775±Btu) and will require beneficiation.—Author's abstract

03796 **Parks, William S.** Geologic map of the Hebron quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 440-NW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Hebron quadrangle, Tennessee," by C. R. Sykes is cited separately.—MCM

03564 **Parry, W. T.; Reeves, C. C., Jr.** Clay mineralogy of pluvial lake sediments, southern High Plains, Texas: Jour. Sed. Petrology, v. 38, no. 2, p. 516–529, illus., table, 1968.

Lacustrine sediments from six pluvial lake basins of the southern High Plains, Texas, contain illite, montmorillonite, interstratified illite–montmorillonite, kaolinite, glauconitic mica, and in two basins, sepiolite. Sepiolite, illite–montmorillonite, and glauconitic mica are authigenic; some of the montmorillonite is derived from volcanic ash, but most of the lacustrine clay is detrital and representative of ancient soils of the Llano Estacado. Increase in kaolinite and montmorillonite with depth and corresponding decrease in illite is indicative of a Pleistocene pluvial period antedating Tahoka Clay time (14,000 to 22,000 years B.P.). Lacustrine strata of post-Tahoka age, formed in a closed lake environment, consist of illite, illite montmorillonite, montmorillonite, sepiolite with gypsum, sodium sulfate, glauconitic mica, and dolomite.—Authors' abstract

03505 **Pate, J. Durwood.** Laverne gas area, Beaver and Harper Counties, Oklahoma, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1509–1524, illus., tables, 1968.

The Laverne gas area is unique in Oklahoma in that it contains four stratigraphic traps producing oil and gas from accumulations independent of structural closure. The first gas well in the Laverne district was completed in 1930; however, it was

not until December 1955 that the shallower Laverty "Hoover" gas pay (Virgilian) was discovered. The "Hoover" pay, which has a maximum thickness of 210 ft, is the most productive reservoir in the field, containing more than one-half of the total gas reserves. The rest of the reserves are trapped in sandstones of Missouri and Morrow ages and in limestone of Chester age which underlies the angular unconformity between the two systems. Combined total gas reserve for the "Hoover", Tonkawa, Morrow, and Chester reservoirs in the field is 2,827 billion cu ft.—*from* Author's abstract

03668 **Patel, A. R.; Koshy, Jacob.** Cleavage and etching of barite: Canadian Mineralogist, v. 9, pt. 4, p. 539–546, illus., 1968.

Natural single crystals of barite obtained from Silver Band mines, Westmorland have been cleaved parallel to [001] and [110]. Interferometric examination has revealed that [110] cleavages are better than [001]. This may be due to the difference in binding energy between atoms in the same plane and atoms in the neighbouring plane. The cleavages have been etched in H_2SO_4 and HCl; pit densities differ when etched in different acids. Matched pairs have been etched, one in H_2SO_4 and its counterpart in HCl; one-to-one correspondence is not observed, contrary to what has been reported so far in other mineral crystals. If cleavages once etched in one etchant are re-etched in the other, correlation in the etch pattern is obtained. Implications are discussed.—*from* Authors' abstract

03748 **Paterson, W. S. B.** Glacier surges: Canadian Alpine Jour., v. 51, p. 220–223, illus., 1968.

Mountaineers on the Yukon Centennial Expedition, 1967, were able to see, in Steele and Walsh Glaciers, examples of a rare form of glacier behavior, a surge. In a surge, a glacier, after showing little sign of unusual activity, starts to flow at about 100 times normal velocity due to rapid down-valley movement of existing ice. The surface level drops in the upper reaches leaving fringes of ice attached to the walls, and ice cliffs where tributary glaciers have been sheared off. Discharge of ice from these tributaries forces the medial moraine into loops. Suggested causes are: a delayed response to avalanches on to the glaciers during earthquakes; some change in the glacier bed, perhaps temperature; or an increase in water.—ESL

03864 **Paulson, Oscar L., Jr.** Correlations in Austin Group of Texas: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 864–866, illus., 1968.

In a recent study of the Ostracoda from the Austin Group of Texas, the writer found that four species are useful in correlating the sequences exposed in Travis, Dallas, and Fannin Counties. The use of these microfossils fills the gaps left by the absence of macrofauna previously used in correlation and illustrates their utility in areas where the stratigraphy is complicated by facies changes.—Author's abstract

Paulson, Q. F. *See* Hamilton, L. J. 03693

Pelletier, Y. J. A. *See* Blackburn, W. H. 03258

03272 **Perrault, Guy.** La composition chimique et la structure cristalline du pyrochlore d'Oka, P. Q. [with English abs.]: Canadian Mineralogist, v. 9, pt. 3, p. 383–402, illus., tables, 1968.

Complete chemical analyses are given for five varieties of pyrochlore from Oka. Compositions agree well with the structural formula $A_{16}B_{16}O_{48}F_8$ where A is occupied mostly by Ca^{2+}, Na^{+} and Ce^{3+}, and B by Nb^{5+}. Pyrochlore no. 5 is the only one showing a significant deficiency in the occupation of A sites (15.1 for 16 possible); this appears to be related with an excess of $(OH)^{-}$ probably located in O^{2-} sites. Heat treatment of metamict pyrochlores causes a contraction of *a*. Crystal structure analysis for the parameter of the O^{2-} ion gives values of 0.316 (pyrochlores 1 to 4) and 0.330 (pyrochlore 5). Interatomic distances agree with known observations. Nb-O bonds are probably much stronger than Ca-O bonds.—*from* English abstract

03603 **Perrault, Guy; Hébert, Paul.** Minnesotaite from the Bluebell Mine, Riondel, B. C. [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 579, 1968.

Petrak, John A. *See* Chinnery, Michael A. 03921

03512 **Picard, M. Dane; Brown, Boyd R.; Loleit, A. J.; Parker, J. W.** Outline of occurrence of Pennsylvanian gas in Four-Corners region, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1327–1356, illus., tables, 1968.

Gas occurs in four zones in Desmoinesian carbonate rocks, all in the Paradox Member of the Hermosa Formation. These are, from oldest to youngest: Barker Creek, Akah, Desert Creek, and Ismay; they are shelf counterparts of basinal evaporitic sequences. Gas is in calcirudite, calcarenite, and sparsely fossiliferous carbonate which is nearly in place and was deposited in biostromal and biohermal complexes. Dolomitization and other diagenesis has occurred. Vuggy and intercrystalline porosity are predominant; fracture porosity is important in places. The type of trap is hard to define from subsurface control, although all of the gas is found on structural highs of varied relief and area. Compaction contributed to the relief and warping has occurred. Stratigraphic variations contribute to trapping and may be controlling factors.—*from* Authors' abstract

03533 **Picard, M. Dane; High, Lee R., Jr.** Shallow marine currents on the early(?) Triassic Wyoming shelf: Jour. Sed. Petrology, v. 38, no. 2, p. 411–423, illus., tables, 1968.

Analysis of 690 asymmetric ripple mark and 40 cross-stratification paleocurrent directions from 37 localities in the Red Peak Formation indicates three major current directions: northeast, southwest, and northwest. They are interpreted respectively to represent wave drift, rip, and longshore currents moving on, off, and along a northwest-southeast oriented coast. Visual interpretation of the plotted patterns was used; vector analyses techniques were inadequate. Evidence suggests that symmetrical and asymmetrical ripple marks are not wave- and current-formed respectively, but rather, since all are somewhat asymmetrical, are due to currents (and waves in shallow water) alone.—HRC

03572 **Picard, M. Dane; High, Lee R., Jr.** Sedimentary cycles in the Green River Formation (Eocene), Uinta Basin, Utah: Jour. Sed. Petrology, v. 38, no. 2, p. 378–383, illus., 1968.

Several cyclic patterns occur in deposits of fluvial, shallow lacustrine, and deep lacustrine environments in the Parachute Creek Member of the Green River Formation (Eocene), northeastern Uinta Basin, Utah. Individual cycles may be traced laterally, and ideal patterns correlated. Changes in the level of Lake Uinta, possibly resulting from climatic fluctuations, are postulated as the direct cause of the cycles. The presence of such correlative cycles in different facies imposes restrictions upon possible modes of origin, and aids in the reconstruction and interpretation of Lake Uinta.—Authors' abstract

03285 **Pickett, E. E.; Koirtyohann, S. R.** Nitrous oxide–acetylene flame as an emission source for the determination of aluminum, gallium, indium, thallium, germanium, and tin [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 360, 1968.

Pickett, E. E. *See* Koirtyohann, S. R. 03286

03824 **Pickett, G. R.** Properties of the Rocky Mountain Arsenal disposal reservoir and their relation to Derby earthquakes, *in* Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well, Pt. A: Colorado School Mines Quart., v. 63, no. 1, p. 73–100, illus., tables, 1968.

Analyses of fluid injection volume data and transient pressures indicate that the disposal reservoir has a total fluid volume between 0.6 and 1.9×10^9 bbl. Before start of injection in 1962, reservoir pressure was 300 to 1400 psi subhydrostatic and after cessation in 1966, about 100 psi. An empirical correlation exists for the

injection history between cumulative number of earthquakes and calculated static pressure. Assuming that the entire reservoir follows the same pressure vs number of earthquakes curve for the most permeable part, then the final equilibrium pressure of the entire reservoir can be measured. Empirical comparison of injection energy with earthquake magnitudes shows that if injection energy is returned as earthquake energy, it is stored for significant lengths of time before release. Assuming that all injection energy has now been returned as earthquake energy, total energy magnitude is consistent with energy–earthquake magnitude relations proposed by Richter.—*from* Author's abstract

03488 **Pike, Stuart J.** Black Warrior basin, northeast Mississippi and northwest Alabama, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1693–1701, illus., table, 1968.

Seven upper Mississippian gas fields and a one-well Ordovician oil field are known. Paleozoic through Mississippian strata are more than 17,000 feet thick and are overlain by 10,000 feet of Pennsylvanian rocks. The strata are complexly faulted and most of the gas fields are on faulted structures. All of the gas is in Chester sands which have a marked lack of lateral persistence and extreme lateral and vertical variations in porosity and permeability. The eight-well Muldoon field, the largest in the basin, is on a horst-like fault block and production comes from the Sanders Sandstone. There are several unconformities in the basin offering more possibilities.—HRC

03923 **Pilbeam, David.** The earliest hominids: Nature, v. 219, no. 5161, p. 1335–1338, table, 1968.

Pilbeam believes that the late Miocene *Ramapithecus* is a hominid and still earlier hominids are to be expected. Fossil evidence at the moment indicates that hominids were recognizably distinct from pongids 14 m.y. ago, that certain early Miocene species are ancestral to gibbons, chimpanzees, and gorillas, and that many of the "basic hominoid similarities" are likely therefore to be parallelisms.—KAF

03541 **Pilkey, Orrin H.; Blackwelder, Blake W.** Mineralogy of the sand size carbonate fraction of some Recent marine terrigenous and carbonate sediments: Jour. Sed. Petrology, v. 38, no. 3, p. 799–810, illus., 1968.

A wide variety of marine sediments were examined in order to determine the factors controlling modern carbonate mineral distribution. The sand-sized fraction was utilized exclusively in order to make possible identification of components and to minimize masking effects of non-carbonate material during X-ray diffraction analysis. Factors controlling mineral distribution include the original mineralogical components being formed as well as the nature and extent of alteration processes. These factors are directly related to depth, but show little latitudinal correlation.—Authors' abstract

03575 **Pincus, Howard J.; Ali, Syed A.** Optical data processing of multispectral photographs of sedimentary structures: Jour. Sed. Petrology, v. 38, no. 2, p. 457–461, illus., tables, 1968.

Two-dimensional Fourier transforms (diffraction patterns) of photographs of the same specimen illuminated in five different ways provide a means for comparing the information so obtained. Faint cross-lamination in a specimen of Fairview Limestone is best revealed by transmitted infrared radiation.—Authors' abstract

03944 **Pitman, Walter C., 3d; Hayes, Dennis E.** Sea-floor spreading in the Gulf of Alaska: Jour. Geophys. Research, v. 73, no. 20, p. 6571–6580, illus., 1968.

The data presented show that the magnetic lineations found off the west coast of the United States extend into the Gulf of Alaska. The magnetic pattern in the Gulf of Alaska is subparallel to the eastern limb of the Great Magnetic Bight of the northeast Pacific and is offset by one or more east-west fracture zones. The sequence of anomalies is continuous with those of the Great Magnetic Bight. The magnetic lineations are identified as a part of the lineation pattern recognized in

the world's oceans. An offset migratory ridge system is proposed to explain the unique form of the lineations and the tectonic pattern of the northeast Pacific region in terms of ocean-floor spreading. Two episodes of spreading are suggested. Authors' abstract

03553 **Pittman, Edward D.; Lumsden, David N.** Relationship between chlorite coatings on quartz grains and porosity, Spiro Sand, Oklahoma: Jour. Sed. Petrology, v. 38, no. 2, p. 668–670, illus., 1968.

Authigenic chlorite coatings on detrital quartz grains influence the formation of overgrowths and preservation of porosity in the Spiro Sand, Arkoma Basin, Oklahoma. Thick continuous coatings preserve porosity because pressure solution is retarded and quartz overgrowths are nonexistent. If the coatings are sparse, thin, and discontinuous, the sandstone is nonporous because of pressure solution and quartz overgrowths. Intermediate stages between these two stages are present. Authors' abstract

03496 **Planalp, Roger.** Geology of Aetna gas field, Franklin and Logan Counties, Arkansas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1668–1681, illus., 1968.

Gas in the Aetna field comes from the Atoka and Morrow Formations of Pennsylvanian age; it is almost 98 percent methane. Trapping is effected by structure, faulting, and stratigraphic pinchouts. The pre-Mississippian rocks have not been tested on the crest of the Aetna anticline.—HRC

Plant, A. G. *See* Sabina, Ann P. 03670

03248 **Plock, C. E.; Vasquez, J.** Determination of uranium in plutonium by differential linear sweep oscillographic polarography [with French and German abs.]: Anal. Chim. Acta, v. 42, no. 1, p. 101–107, illus., tables, 1968.

The polarographic behavior of uranium in hydroxylamine hydrochloride was investigated by differential oscillographic polarography. A procedure is presented for the determination of uranium in plutonium for concentration of uranium greater than 10 ppm. Analyses of solutions containing 22 common impurities found in plutonium metal revealed that antimony, copper, and titanium cause significant interference. A reversible peak corresponding to a one-electron reduction was obtained with a peak potential of –0.167 V *vs* Hg pool electrode. The diffusion coefficient is $0.51 \cdot 10^{-5}$ cm^2/sec and the diffusion current constant is 1.59 with an average relative standard deviation of 2.28 percent. The peak current of uranium can be affected by hydrochloric, nitric, perchloric, and sulfuric acids, depending on the acid concentration.—Authors' abstract

Polishuk, Paul. *See* Dooley, John A. 03319

03869 **Pollard, Jack C.; Duty, Robert S., Jr.; Teague, Norman P.** Robert Hillyer Ray (1902–1968): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 867, portrait, 1968.

03646 **Pollock, E. N.** The spectrophotometric determination of tellurium with bismuthiol II after separation with 4,4′-methylenediantipyrene and 1,1,2,2-tetrachloroethane [with French and German abs.]: Anal. Chim. Acta, v. 40, no. 2, p. 285–290, tables, 1968.

Tellurium can be isolated from most other elements by the extraction of its complex with 4,4′-methylenediantipyrene into 1,1,2,2-tetrachloroethane. After isolation tellurium can be determined photometrically as its complex with bismuthiol II in chloroform. The procedure can be applied to copper and copper-based materials in the presence of many elements normally associated with copper, including selenium. The procedure is lengthy but straightforward, precise and subject to few interferences.—Author's summary

Poole, Forrest G. *See* Stewart, John H. 03837

03287 **Popham, Ronald E.; Schrenk, William G.** New look at calcium flame interferences [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 360, 1968.

03334 **Prather, R. W.; McCourt, G. B.** Geology of gas accumulations in Paleozoic rocks of Alberta Plains, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1238–1284, illus., tables, 1968.

Paleozoic rocks are predominantly shelf carbonates, limy marine shale, and evaporites up to 5,000 feet thick. Major reservoirs are Devonian and Mississippian organic and clastic carbonates of three trap types—reefs, lithologic pinchouts, and unconformity traps. "Draped" anticlinal structure aided accumulation in Nisku reefs. Devonian reefs of Swan Hills, Leduc, and Nisku units mark shoaling areas as later Devonian seas transgressed the evaporite-filled Elk Point basin; reefs contain reserves of 8 trillion cu ft. In lithologic pinchouts of the Wabamun Group, hydrogen-sulfide gas includes reserves of 1.8 trillion cu ft residue gas and 35 million long tons sulfur. Gas in Mississippian rock associated with the post-Paleozoic unconformity amounts to 8.2 trillion cu ft. Estimated potential gas resources in Paleozoic rocks are 45 trillion cu ft.—*from* Authors' abstract

Proctor, P. D. *See* Nackowski, M. P. 03846

03604 **Radcliffe, D.** Chemistry of safflorite-loellingite [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 579, 1968.

03663 **Radcliffe, Dennis.** Structural formula and composition of skutterudite: Canadian Mineralogist, v. 9, pt. 4, p. 559–563, illus., tables, 1968.

The composition and stoichiometry of several skutterudite specimens were determined with a microprobe, as skutterudite is often zoned and intergrown with safflorite. Maximum concentration obtained was 82 percent $CoAs_3$, 7 percent $NiAs_3$, and 11 percent $FeAs_2$; cell dimensions averaged 8.21 A. The structural formula for two specimens was calculated and indicates total Co, Fe, and Ni in excess of the 8 required for the A position, and total As and S less than the 24 required for the B position. The grosser deficiency of As reported in previous analyses is probably due to safflorite intergrowths.—ESL

03649 **Ramakrishna, T. V.; West, Philip W.; Robinson, James W.** The determination of calcium and magnesium in acetylene flames: Anal. Chim. Acta, v. 40, no. 2, p. 347–350, tables, 1968.

The results of investigations with air-acetylene and nitrous oxide-acetylene flames for determining Ca and Mg by atomic absorption spectroscopy are presented. Methods are proposed for overcoming the few interferences found. The determination is more selective than with oxy-hydrogen flames, and the decrease in interference in nitrous oxide-acetylene flame is especially marked.—ESL

03281 **Ramríez-Muñoz, Juan.** Some difficult working areas in atomic-absorption flame photometry [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 360, 1968.

Rapp, E. G. *See* Cherry, J. T. 03810

Rasberry, Stanley D. *See* Margoshes, Marvin. 03302

Rasetti, Franco. *See* Bird, John M. 03657

03739 **Ravindra, Ravi.** Usual assumptions in the treatment of wave propagation in heterogeneous elastic media: Pure and Appl. Geophysics, v. 70, no. 2, p. 12–17, 1968.

Special assumptions are usually made in seismology in the treatment of wave propagational problems in heterogeneous elastic media. These assumptions are pointed out and some of them are critically examined.—Author's summary

03890 **Rea, David K.; Bryant, Donald L.** Permian red chert–pebble conglomerate in Earp Formation, southeastern Arizona: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 809–819, illus., tables, 1968.

The Permian Earp Formation can be divided into three members: the lower limestone member, the middle terrigenous member, and the upper interbedded clastic and carbonate member. The red chert–pebble conglomerate is a single, possibly isochronous unit, within the middle terrigenous member. Meandering streams, bringing red chert pebbles south from the eroding Naco Formation in the area of Winkelman and Superior, Arizona, deposited the conglomerate. The source of clastics in the lower limestone member seems to be in the south and southwest, probably in north–central Mexico. This member undergoes a gradational facies change eastward where, devoid of clastics, the lower limestone member of the Earp Formation is transitional into the upper part of the Horquilla Limestone of southwestern New Mexico.—Authors' abstract

03503 **Reedy, Harold J.** Carter–Knox gas field, Oklahoma, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1476–1491, illus., 1968.

The field, at the southeastern end of the Anadarko basin, produces oil with associated gas from the Permian, and the Hoxbar, Deese, and Springer Groups. Gas–condensate production is from the Simpson Group; the Bromide Formation is the most important zone. Permian strata form an elongate, faulted anticline with shallow dips; the deeply–eroded Pennsylvanian rocks form a steeply–dipping, faulted anticline, and the pre–Pennsylvanian structure is an anticline parallel with the shallower features but about one mile to the west.—*from* Author's abstract

03902 **Rees, A. I.** The production of preferred orientation in a concentrated dispersion of elongated and flattened grains: Jour. Geology, v. 76, no. 4, p. 457–465, illus., 1968.

A statistical alignment of long and short axes of grains of a concentrated dispersion in a fluid might be produced as a result of the encounters occurring between elastic particles during shearing of the dispersion. The alignment of longest axes approximately in the direction of motion and shortest axes in the direction of maximum velocity gradient was observed in samples collected from two sets of sand dunes. Preferred orientations of grain axes was estimated by a method based on the measurement of magnetic susceptibility.—FSF

Rees, A. I. *See* Hamilton, N. 03903

Reeves, C. C., Jr. *See* Parry, W. T. 03564

03807 **Reitan, Paul H.** Frictional heat during metamorphism—Quantitative evaluation of concentration of heat generation in time: Lithos, v. 1, no. 2, p. 151–163, illus., tables, 1968.

Effects of time as a variable in relation to frictional heat generation during deformation which involves slip along interfaces is evaluated for several models. Two model series in which total energy converted to heat is constant, but time varies, indicate that when significant strain is accomplished in geologically relatively short time periods (10^{11} to 10^{13} sec) frictionally generated heat will not be conducted away rapidly enough to prevent appreciable elevation of temperature in and around the deforming region. When deformation is distributed uniformly over periods of 10^{14} to 10^{15} sec, maximum temperature increase cannot be expected to exceed about 10°C. It is concluded that frictionally generated heat along with other heat sources may contribute signifcantly to the heat budget of dynamothermally metamorphosed rocks.—*from* Author's abstract

03509 **Reutinger, C. A.** Natural gas in Permian and Cisco beds of Red River and Electra Arch, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1455–1458, illus., table, 1968.

This paper describes the shallow accumulations of solution and nonassociated gas along the Red River and Electra arch. The first commercial well in North Texas was a nonassociated-gas well completed in 1907 in this area. The first commercial oil well in North Texas was completed in 1910 in this area. Both the nonassociated gas and solution gas are practically depleted, but the history of a pioneer development and some of the "firsts" credited to the province are of interest. Author's abstract

Rex, R. W. *See* Syers, J. K. 03933

Rieke, Herman H., 3d. *See* Chilingarian, George V. 03542

03605 **Rimsaite, J.** Micas and associated minerals from two Li-pegmatites [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 580, 1968.

03721 **Robbins, C. R.** Synthetic $CaTiSiO_5$ and its germanium analogue ($CaTiGeO_5$): Materials Research Bull., v. 3, no. 8, p. 693–698, 1968.

Synthetic, anhydrous $CaTiSiO_5$ (sphene) and $CaTiGeO_5$ are monoclinic with lattice constants $a=6.567\pm0.005$, $b=8.723\pm0.005$ $c=7.454\pm0.005$ A, $\beta=119°\ 52'\pm2'$ and $a=6.65\pm0.01$, $b=8.92\pm0.01$, $c=7.49\pm0.01$ A, $\beta=119°\ 45'\pm10'$ respectively. There are four formula units per cell. Cell dimensions of the silicate are close to those of natural sphene. The space group is $P2_1/n$ as compared with space group C2/c reported for natural minerals of variable composition and general formula $CaTiSiO_4$ (O,OH,F). Although X-ray intensities indicate a general structural similarity, some of the low-order (h+k odd) reflections of the synthetic crystals are fairly strong, indicating appreciable shifts from the C2/c structure.—Author's abstract

Robinson, James W. *See* Ramakrishna, T. V. 03649

03551 **Rooney, Lawrence F.; French, Robert R.** Allogenic quartz and the origin of penemosaic texture in evaporites of the Detroit River Formation (Middle Devonian) in northern Indiana: Jour. Sed. Petrology, v. 38, no. 3, p. 755–765, illus., tables, 1968.

Anhydrite in the Detroit River Formation has a "chicken wire" or mosaic texture, but since thin, contorted layers of limestone do not form complete envelopes, the resulting texture is defined as penemosaic. Insoluble residue studies on 36 samples of anhydrite and gypsum and 47 samples of the interbedded limestone layers and masses from 12 cores provide convincing evidence that the formation texture here is not a replacement phenomenon. Concentration of allogenic quartz in the interbedded limestone layers and masses suggests that they were deposited in a higher energy environment than were the enclosing sulfate rocks, the overlying limestone, or the underlying dolomite. Such an environment could have been produced under sebka conditions or by interruptions of lagoonal sedimentation.—*from* Authors' abstract

Rose, Harry J., Jr. *See* Cuttitta, Frank. 03276

Rose, Harry J., Jr. *See* Cuttitta, Frank. 03311

03493 **Rose, W. D.** Gas-productive areas in western Kentucky, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1759–1760, 1968.

Gas is not common in western Kentucky. The biggest field is the Midland gas field where gas has accumulated on an isolated sand-filled Bethel channel cut to a depth of more than 200 feet into the underlying limestone; the reservoir is from 0.5 to 2 miles wide and 10 miles long. Gas accumulated in the updip flank of the main channel and is limited by the change of direction in the channel from east-west to northwest-southeast where the channel cuts downdip and so limits accumulation. There is some structural control in that the gas is confined to the channel where it parallels the strike of the beds. Other, smaller fields also are present in the Bethel Sandstone and other Chester sandstones.—HRC

03666 **Ross, G. J.** Structural decomposition of an orthochlorite during its acid dissolution: Canadian Mineralogist, v. 9, pt. 4, p. 522–530, illus., tables, 1968.

The Mg, Fe, and Al of a clinochlore were dissolved at the same rate in Si-saturated 2 *N* HCl at 60°C indicating a nonpreferential removal of "octahedral" and "tetrahedral" cations and suggesting a dissolution process in which the hydroxide sheet and the 2:1 sheet in the chlorite layer were equally attacked. The chemical data also suggested that the acid attack on the chlorite particles proceeded from the edges inwards along a well-defined reaction boundary leaving a reacted layer which formed a diffusion barrier. The combined evidence from X-ray diffraction and thermal analyses confirmed the equal attack on the two component sheets in the chlorite layer and the progress of the reaction along a well-defined reaction boundary but did not support unequivocally the diffusion-controlled reaction rate suggested by the chemical data.—Author's abstract

03805 **Roth, C. B.; Jackson, M. L.; Lotse, E. G.; Syers, J. K.** Ferrous-ferric ratio and CEC changes on deferration of weathered micaceous vermiculite: Israel Jour. Chemistry, v. 6, no. 3, p. 261–273, illus., tables, 1968.

Under strongly reducing conditions, appreciable decrease in Fe^{3+} and reciprocal increase in Fe^{2+} of micaceous vermiculite layers occurs. The content of Fe^{3+} is largely restored by subsequent H_2O_2 treatment. The CEC increase resulting from the deferration of sesquioxide-coated micaceous vermiculite is attributed to unblocking of the exchange sites that had been blocked by the positive charge of the sesquioxide coating. Because the oxidation of Fe^{2+} in previously deferrated micaceous vermiculite to Fe^{3+} produces no significant decrease in CEC, the neutralization of additional positive charge is attributed to depronation of structural hydroxyls: Fe^{2+} + structural (OH^-) + 1/2 $H_2O_2 \rightarrow Fe^{3+}$ + structural (O^{2-}) + H_2O.—Authors' conclusions

03489 **Roth, Ernest E.** Natural gases of Appalachian basin, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1702–1715, illus., table, 1968.

The Appalachian basin extends from southwestern Ontario to Alabama. Gas has been found in rocks of all Paleozoic periods in several different types of traps, which, for the most part, are relatively shallow. Gas should be present in the deeper parts of the basin but detection is difficult. Methane makes up about 85 percent of the gas and ethane and other lighter fractions the remainder. There is an appreciable amount of the inerts, especially in the deeper gas.—HRC

Rowe, Gilbert T. *See* Menzies, Robert J. 03727

03623 **Ruch, R. R.** Neutron activation analysis at the Illinois State Geological Survey: Illinois Geol. Survey Indus. Minerals Note 34, 8 p., illus., tables, 1968.

Neutron activation analysis, a relatively new analytical tool for determining the presence of trace and minor elements, has been added to the Illinois State Geological Survey facilities. The new technique has been applied to such Illinois materials as clays, coal and its ash, fluorspar, crude oil, limestone, chert, and argillaceous sediments. Water leached from sanitary landfills also has been analyzed for minor elements.—Author's abstract

Rucklidge, J. C. *See* Fawcett, J. J. 03590

Rucklidge, J. C. *See* Naldrett, A. J. 03601

Rucklidge, J. C. *See* Cabri, L. J. 03763

03606 **Rucklidge, John.** Electron probe data for some Canadian platinum metal minerals [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 580, 1968.

03521 **Ruhe, R. V.; Dietz, W. P.; Fenton, T. E.; Hall, G. F.** Iowan drift problem, northeastern Iowa: Iowa Geol. Survey Rept. Inv. 7, 40 p., illus., tables, 1968.

Problems of the Iowa drift are reviewed, taking into consideration radiocarbon dates, topographic features, and subsurface stratigraphy. It is concluded that the till beneath the loess or loam sediments is either Kansan or Nebraskan. The stone line (Iowan pebble band) was formed mainly by erosion by running water, but much time was involved in its formation, and the stone line and the loess are closely related in time. The loess is much younger than the drift—the loess being Wisconsinan and the tills Kansan and Nebraskan. The Iowan surface served as a loess source. Sand was added to the loess of divide remnants and to the Kansan area at the border. The silt also would have been available for eolian transport. The implications of this study are examined.—MST

03639 **Runcorn, S. K.** Polar wandering and continental drift [with French abs.], *in* Continental drift, secular motion of the pole, and rotation of the Earth–Internat. Astron. Union, Symposium No. 32, Stresa, Italy, 1967: Dordrecht, Holland, R. Reidel Publishing Co., and New York, Springer–Verlag, p. 80–85 illus., 1968.

The relations between paleomagnetic observations, polar wandering curves, and changes in the speed of rotation of the Earth are discussed.—Author's abstract

Russell, Ernest E. *See* Wilson, Charles W., Jr. 03580

03581 **Russell, Ernest E.** Geologic map of the Counce quadrangle, Tennessee (including the Tennessee portion of the Doskie quadrangle, Mississippi–Tennessee): Tennessee Div. Geology Geol. Map GM 13–SE, scale 1:24,000, separate text, 1968.

The accompanying text describes the sand and gravel deposits which have been mined for many years in the Counce quadrangle; they are principally in the southwestern uplands and in the northeast near Pyburns and Nixon, and in channels and flood plains of the Tennessee River and its major tributaries.—MCM

Russell, Ernest E. *See* Wilson, Charles W., Jr. 03701

Rützler, Klaus. *See* Towe, Kenneth M. 03854

Ryan, D. E. *See* Frei, R. W. 03249

Ryder, W. A. *See* Woodriff, R. A. 03277

03670 **Sabina, Ann P.; Jambor, J. L.; Plant, A. G.** Weloganite, a new strontium zirconium carbonate from Montreal Island, Canada: Canadian Mineralogist, v. 9, pt. 4, p. 468–477, illus., tables, 1968.

Weloganite occurs in an alkalic sill which has intruded Ordovician limestone at St-Michel, Montreal Island, Quebec. Chemical analysis of the new mineral is ideally $Sr_5Zr_2C_9H_8O_{31}$. Weloganite is trigonal, space group $P3_12$, hexagonal dimensions $a=8.96$, $c=18.06$ A, $D_m=3.22$, $D_c=3.26$ for $Z=2$. The strongest lines of the X-ray powder pattern are 2.81 A (10), 4.35 (9), 2.59 (7), 2.227 (7), 2.009 (7). The mineral occurs predominantly as yellow crystals which are roughly hexagonal in outline and typically irregular in width.—*from* Authors' abstract

03874 **Sackett, William M.** Carbon isotope composition of natural methane occurrences: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 853–857, illus., tables, 1968.

Decreasing time, temperature, and bond strengths result in an enrichment of C-12 in methane produced by experimental thermal cracking of naturally occurring organic materials. Similar C–12 enrichments with decreasing reservoir depths are shown by published analyses on the isotopic composition of natural methane occurrences. Conditions at formation seem to be more important than migration or bacterial *versus* chemical processes in determining natural variations.—Author's abstract

03802 **Saines, Marvin.** Map interpretation and classification of buried valleys: Ground Water, v. 6, no. 4, p. 32–37, illus., 1968.

Buried valleys are classified into two main types—those [preglacial or interstadial] valleys completely buried by glacial drift, without present streams along their courses (Type I), and those partly buried or partly exhumed, usually with present streams along their courses (Type II). If a stream is flowing mainly in a Type II valley, the bottom of which is deeply buried by drift, local areas where the stream is cutting bedrock are postglacial channels of derangement. Postglacial channels of derangement, which often can be recognized on a topographic map, reveal that a buried valley (often Type I) exists nearby.—Author's abstract

03818 **Sakhno, V. G.; Shcheka, S. A.; Kurentsova, N. A.; Makarova, Zh. A.** Vklyucheniya shpinelevykh peridotitov v bazal'takh vulkana Oakhu (Gavayskiye ostrova): Akad. Nauk SSSR Doklady, v. 180, no. 1, p. 199–201, table, 1968.

Spinel-bearing peridotite inclusions in basalts from Oahu volcano in the Hawaiian Islands are described. The chemical data indicate that the composition of the minerals is somewhat variable even in inclusions of this one rock type from one flow. The mineralogical and petrographic features of the inclusions (texture, mineralogic composition, interrelations with the basalt) resemble the garnet peridotite inclusions in kimberlites and the spinel-bearing peridotites in the alkali basalts of other regions.—DBV

03819 **Salisbury, Gerald P.** Natural gas in Devonian and Silurian rocks of Permian basin, West Texas and southeast New Mexico, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1433–1445, illus., 1968.

Devonian reservoirs in the Permian basin produce only gas in the south and west parts, gas condensate and high gas/oil ratio near the center of the basin, and oil alone in the north. Methane in the gas varies systematically also, from more than 90 percent in the south to less than 30 percent in the northeast; methane variation is independent of other gases and crude oil compositions. Only gas is indicated from the Silurian–Devonian rocks in the Delaware and Val Verde basins. No pattern of gas distribution exists; methane simply becomes more predominant towards the Marathon thrust belt. The gas pattern may be a result of the methane distribution in the formation water moving away from the thrust belt as a result of overthrusting. Carbon dioxide may have been distributed similarly at a later time and in smaller volumes.—*from* Author's abstract

03247 **Sanders, John E.** Stratigraphy and primary sedimentary structures of fine grained, well-bedded strata, inferred lake deposits, Upper Triassic, central and southern Connecticut, *in* Late Paleozoic and Mesozoic continental sedimentation, northeastern North America—A symposium: Geol. Soc. America Spec. Paper 106, p. 265–305, illus., tables, 1968.

Upper Triassic strata and lava that filled a subsiding N–S fault trough were tilted eastward, folded, and faulted prior to Late Cretaceous time. Coarse-grained fan deposits are along the eastern margin; fine-grained, well-bedded deposits, with basalt layers, are more distant. Most of them are red flood-plain deposits; some are intercalated with gray lake beds and black swamp deposits. Near Branford the fine-grained strata are in two formations, at localities within 1 km of the eastern fault, where younger and older strata are coarse conglomerates. Two separate large, deep lakes submerged the alluvial fans high up on the escarpment, but when not so high allowed uninterrupted alluvial fan deposition. Paleocurrent indicators were diversely oriented by lake bottom topography. Pillows and volcanic breccia resulted when hot lava hit cold lake water.—GDC

03537 **Sanders, John E.; Friedman, Gerald M.; Bennin, Robert S.** Procedure for recovering bottom and interstitial waters from cores of sandy sediments from the continental shelf: Jour. Sed. Petrology, v. 38, no. 2, p. 683–684, illus., 1968.

Various coring techniques can be used to recover not only bottom sediment but also a sample of bottom water and the interstitial water below the water/sediment interface. Commercially available plugs inserted at the top of the core liner tube create a tight seal. From such sealed cores segments can be cut off one at a time

from the bottom. Within each is a sample of undisturbed interstitial water, which can be recovered in a pressure-type squeezing vessel.—Authors' abstract

03728 **Santo, Tetsuo.** Lateral variation of Rayleigh wave dispersion character—Pt. 5, North American continent and Arctic Ocean [with Japanese abs.]: Tokyo Univ. Earthquake Research Inst. Bull., v. 46, pt. 3, p. 431–456, illus., tables, 1968.

Regionalization of the North American continent, the Arctic Ocean basin and their surroundings with regard to group velocity dispersion character of Rayleigh waves (period 20–40 sec) was made by the "crossing-path technique". In the Canadian shield the dispersion index was as low as 5.5; this is discussed in light of dispersion data obtained by J. N. Brune et al (1963). No special dispersion character is observed along the narrow seismic belt in the Arctic Ocean considered to be the extension of the Mid-Atlantic Ridge. A region of extremely high dispersion index of 10 was again confirmed around Novaya Zemlya. A peculiar dispersion of waves along the path covering Greenland was discovered [and is explained as probably due to the ice sheet].—*from* Author's abstract

Sauer, V. B. *See* Harder, A. H. 03766

03848 **Sayers, R. W.; Tippett, M. C.; Fields, E. D.** Duval's new copper mines show complex geologic history: Mining Eng., v. 20, no. 3, p. 55–62, illus., 1968.

Copper Canyon and Copper Basin are two large and quite different porphyry copper deposits in Lander County, Nevada. The Copper Canyon deposit, the larger of the two, consists mostly of hypogene sulfides occurring as disseminated grains and as fillings in fractures and along bedding planes in the favorable lower conglomerate of the Pennsylvanian Battle Formation. In contrast, the Copper Basin deposit consists of disconnected orebodies of predominantly supergene chalcocite wholly contained within the highly fractured Upper Cambrian Harmony Formation. Significant gold and silver values are found in the Copper Canyon deposit but not in the Copper Basin deposit. Intrusions of quartz monzonite and pre- and post-mineral faulting are associated with both deposits.—FCC

03928 **Schimke, Gerald R.; Bufe, Charles G.** Relationship of Chautauqua Seamount to seafloor spreading in the North Pacific Ocean: Nature, v. 219, no. 5161, p. 1351–1352, illus., 1968.

Chautauqua Seamount is one of a north-south trending group of seamounts 155 km west of Kauai. Strong arguments can be put forward for a Cretaceous age of Chautauqua Seamounts. It is postulated that a fixed locus of magma generation caused the formation of the Emperor seamounts when the Darwin Rise was active, and subsequently caused the Hawaiian Islands when the East Pacific Rise developed. Chautauqua was at lat 7° S., long 137° W., 114±24 m.y. ago.—*from* Authors' abstract

03752 **Schirner, Silas W.** Continued study of the growth of earth science offerings in Iowa secondary schools: Iowa Acad. Sci. Proc. 1966, v. 73, p. 340–344, tables, 1968.

There were seven districts teaching earth science in 1960 and 53 in 1965, an increase of 657.1 percent. In September of 1967, there were 82 districts offering the course, a 54 percent increase in one year. Included tables about earth science classes and teachers in Iowa public schools for the two years of 1964–1965 and 1965–1966 make a comparison of the following: undergraduate majors and teachers, graduate majors of teachers, grade level at which the course is taught, size of classes, total semester hours of teacher's college credit, highest degree held by teacher, tenure of teacher in present position, total years experience of teacher, salaries of teachers, age of teachers, and sex and marital status of teachers.—*from* Author's abstract

03867 **Schleh, E. E.** Stratigraphic evidence for Late Mississippian instability in western United States: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 767–781, illus., 1968.

In Early Mississippian time stable conditions prevailed across the Cordilleran region, and a thin, uniform, shelf–carbonate lithosome was deposited across western United States. Later Mississippian was characterized by orogenic and epeirogenic unrest in the Cordilleran region. The first regionally significant tectonic pulse in the Antler belt took place in early Meramecian time and is reflected in the record by clastic wedges, unconformities, and structural complexities. Outside of the area adjacent to the Antler belt, instability is reflected by strongly subsiding basins in Utah and Idaho, and by an epeirogenically produced regional sub–Meramecian unconformity through western United States. Clastic wedges in Nevada and Idaho indicate a second major Mississippian pulse in the Antler belt about Chesteran time, and complex facies and local mild deformation a complex paleogeography.—*from* Author's abstract

03555 **Schoen, Robert.** Protection of analytical balances: Jour. Sed. Petrology, v. 38, no. 2, p. 674–675, illus., 1968.

Proper care of analytical balances requires that those supplied with unmarked beam–arrest knobs be marked before use.—Author's abstract

03788 **Schramm, Martin W., Jr.** Application of trend analysis to pre–Morrow surface, southeastern Hugoton Embayment area, Texas, Oklahoma, and Kansas: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1655–1661, illus., 1968.

Trend analysis is a technique used to differentiate trends which may influence a whole region and trends which are influential locally. Because most oil and gas fields are associated with anomalies, trend analysis can prove to be an important prospecting tool. Application of the technique to the pre–Morrow surface in the southeastern Hugoton embayment, using few control wells, reveals objectively the combined residual topographic and structural relief that existed after folding at the end of Mississippian time but before Pennsylvanian deposition.—*from* Author's abstract

Schreiber, Edward. *See* Liebermann, Robert C. 03945

Schrenk, William G. *See* Popham, Ronald E. 03287

03920 **Schwerdtner, W. M.** Intragranular gliding in domal salt: Tectonophysics, v. 5, no. 5, p. 353–380, illus., tables, 1968.

Model fabric patterns for translation gliding in rock salt are constructed on the basis of two metallurgical theories (Calnan and Clews' and Dillamore and Roberts') for intragranular slip. Eleven different model patterns, referred to principal axes of deviatoric mesoscopic stress, are obtained for different types of distortion, but five models are most applicable to domal salt. Patterns are compared with natural halite fabrics for 13 domains of homogeneous strain in two Gulf Coast domes. In some diagrams for domal salt, <100>-poles outline maxima and distinct but incomplete girdles; most exhibit fabric patterns resembling the five realistic models after Dillamore and Roberts. This suggests translation gliding to be the dominant mechanism of tectonic flow, which may be succeeded by annealing recrystallization, and finally destruction of deformational patterns.—*from* Author's abstract

Sendlein, Lyle V. A. *See* Backsen, Lee B. 03640

03642 **Sendlein, Lyle V. A.** Ground water geology of the U.S. Gypsum Company, Sperry Mine: Iowa Acad. Sci. Proc. 1966, v. 73, p. 205–211, illus., 1968.

The geology relating to the U.S. Gypsum Company Sperry Mine, Des Moines County, Iowa, is discussed. Maps of the bedrock configuration, structure, and bedrock geology are presented and reviewed in light of the ground water condition existing in the area. Criteria which could cause mine flooding are investigated and evaluated.—Author's abstract

03569 **SenGupta, J. G.** Determination of fluorine in silicate and phosphate rocks, micas and stony meteorites [with French and German abs.]: Anal. Chim. Acta, v. 42, no. 1, p. 119–125, illus., tables, 1968.

By making certain modifications to a published procedure for fluorine in rocks, it has been possible to improve stability and extend the range of the method. The modified method has been successfully applied to silicate and phosphate rocks, micas, glass and stony meteorites, containing from 60 ppm to 8 percent fluorine. Some precautions are recommended for reliable determination of chlorine.—Author's abstract

03630 **Senich, Donald; Demirel, T.; Handy, R. L.** Effect of Ca-montmorillonite expansion on X-ray diffraction intensities: Iowa Acad. Sci. Proc. 1966, v. 73, p. 212-218, illus., table, 1968.

Odd 00*l* indices, i.e., 001, 003, 005, gave strongest diffraction peaks when d_{001} was in the intermediate range of observed spacings about 14 to 18 A to 19.2 A. Extinctions of the 002, 003, 005, and 006 reflections at certain d_{001} spacings correspond to inferred positions of the oxygen, silicon and oxygen-hydroxyl layers in the pyrophyllite structure. Loss of intensity of the d_{001} diffraction at low and at high d-spacings corresponding to zero relative pressure and to saturation suggest a plane of atoms centrally located in the interlayer region, probably the exchangeable calcium.—*from* Authors' conclusions

03560 **Sharma, M. R.; Krishnaswami, S. P.** Modified centrifuge apparatus for heavy liquid separations:Jour. Sed. Petrology, v. 38, no. 2, p. 648-649, tables, 1968.

Laboratory separation of carbonate minerals having a close range in specific gravity for their identification is difficult. Heavy liquid media separations have been tried, and an improved centrifuge tube has been developed to overcome the difficulty encountered with apparatus suggested earlier. Details of the modified apparatus and experimental results are described.—Authors' abstract

Shcheka, S.A. *See* Sakhno, V. G. 03818

Sherwood, C. B. *See* Grantham, Rodney G. 03662

Shetron, Stephen G. *See* Lotan, James E. 03676

03526 **Shinn, Eugene A.** Selective dolomitization of Recent sedimentary structures: Jour.Sed.Petrology,v.38,no.2,p.612-616,illus.,1968.

Relatively non-dolomitic limestone nodules which float in lithified dolomitic sediment are forming on a supratidal mud flat in the lower Florida Keys. Storm tides periodically deposit layers of lime mud above normal high tide level which dry and crack to form typical mud-crack polygons. These polygons erode into flattened nodules that subsequently become buried in relatively more porous and permeable sediment. Magnesium-enriched brines concentrated through evaporation are more readily transmitted through the more permeable sediment than are the less permeable nodules. Selective dolomitization of the more permeable sediment produces features bearing a strong similarity to sedimentary structures commonly found in ancient dolomitic rocks.—Author's abstract

03931 **Simmons, Gene; Horai, Ki-iti.** Heat flow data 2: Jour. Geophys. Research, v. 73, no. 20, p. 6608-6629, table, 1968.

Heat flow data that have appeared since the compilation of heat flow data made by Lee and Clark (1966) are tabulated in this report.—KAF

Simon, Ruth B. *See* Major, Maurice W. 03822

03717 **Simpson, George Gaylord.** A didelphid (Marsupialia) from the early Eocene of Colorado: Postilla, no. 115, 3 p., illus., 1968.

A specimen of an opossum from Huerfano Basin, Colorado, is described. The specimen consists of a fragment of a right mandibular ramus with M_2 and the talonid of M_1 from the upper part of the Huerfano Formation, substage Gardnerbuttian, considered intermediate in age between the Lost Cabin Member of the Wind River Formation and the Black's Fork Member of the Bridger Formation. The age is

either latest early Eocene or earliest middle Eocene. The specimen is unusually large for an early Tertiary North American didelphine, and is compared with the type of *Peratherium comstocki* Cope, although not assigned to this species.—MST

03843 **Simpson, T. A.** Increasing mineral demands stimulate geological exploration and research: Mining Eng., v. 20, no. 2, p. 61–65, illus., 1968.

Mineral exploration continued at a rapid pace in 1967. Inaccessibility and remoteness are no longer deterrents to exploration, since demand for essential mineral commodities is causing price shifts which encourage exploitation of previously uneconomic deposits. Federal government-sponsored research and development has increased its role in the support and guidance of science and technology. Because of severe shortages of certain metals in this country, old mining districts are being re-examined and new areas, including the continental shelves, are being increasingly studied. New exploration technology is being developed. A summary of many projects underway throughout the U.S. in 1967 is given.—MAC

03607 **Sinclair, A. J.; Mathews, W. H.** Regional variations of minor elements in sulphides, Slocan district, B.C. [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 581, 1968.

03911 **Singer, S. F.** The origin of the Moon and geophysical consequences: Royal Astron. Soc. Geophys. Jour., v. 15, nos. 1–2, p. 205–226, illus., tables, 1968.

A frequency-dependent tidal friction theory is applied to the Earth–Moon system. The most likely origin of the Moon is found to be capture as a separate body, rather than its formation in the vicinity of the Earth from smaller planetesimals. Earlier developments of tidal theory had required an initial orbit of very high inclination and initial obliquity of the Earth's axis of 90°, all of which would have made capture extremely unlikely, and further, required the dissipation of unreasonable amounts of rotational kinetic energy. Urey had favored capture of the Moon for geochemical reasons; we now support this hypothesis because of dynamical arguments. Evidence is presented to support the occurrence of intensive heating and volcanism, both in the Earth and in the Moon, approximately four b.y. ago. Thus, capture of the Moon may explain the apparently anomalously early development of the Earth's atmosphere and oceans.—*from* Author's abstract

03565 **Sippel, R. F.** Sandstone petrology, evidence from luminescence petrography: Jour. Sed. Petrology, v. 38, no. 2, p. 530–554, illus., 1968.

Using well-established but herein modified luminescence petrographic techniques, secondary quartz can be distinguished from primary quartz in sandstones. Solution and overgrowth phenomena can be distinguished. Luminescence not only prevents ambiguity regarding mechanisms but reveals the detrital fabric so that size, shape, and degree of rounding can be seen. Features relating to prior cycles can also be detected. Fractures and crushing events, long since healed, are distinguishable by the technique. Crenulated boundaries also form in the fracturing–healing–recrystallization process resulting in polycrystalline grains showing metamorphic quartzite texture. It is suggested that many of the polycrystalline quartz grains found in sandstones originate in this way either in place or in precursor source rocks.—*from* Author's abstract

03307 **Skinner, H. C. W.** X-ray diffraction analysis techniques to monitor composition fluctuations within the mineral group—Apatite [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 368, 1968.

03879 **Skinner, Morris F.** A Pliocene chalicothere from Nebraska and distribution of chalicotheres in the Late Tertiary of North America: Am. Mus. Novitates, no. 2346, 24 p., illus., tables, 1968.

The occurrence of chalicotheres in the early Pliocene of Nebraska extends the temporal range of the North American Chalicotherioidea. This Pliocene chalicotheres occurrence shows that the group is not restricted to either a late Arikareean or a Hemingfordian age. The vast period of time between the last known Paleogene forms in North America and the earliest Miocene forms suggests that

chalicotheres became extinct in North America and later repopulated the New World from Eurasia. The paleontological evidence that would clearly demonstrate the morphological relationships of the various known Neogene examples is still lacking.—KAF

03257 **Skogerboe, R. K.** Accuracy and precision in flame emission and atomic absorption [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 359, 1968.

03570 **Slatt, Roger M.; Hoskin, Charles M.** Water and sediment in the Norris Glacier outwash area, upper Taku Inlet, southeastern Alaska: Jour. Sed. Petrology, v. 38, no. 2, p. 434–456, illus., tables, 1968.

Thirty-seven surface sediment samples and 11 cores from the tidal portion of this 8-sq mi outwash fan are analyzed. Very poorly sorted muddy sediment and relatively well sorted sand overlie, for the most part, glacial outwash gravel. Mixing of modal size classes has produced complex patterns. The sand and mud are derived largely from Norris and Taku Glaciers; their nature indicates that valley glacier detritus may be fairly rapidly sorted by hydraulic action. No quartz and presence of feldspar in the clay fraction may indicate that physical properties control size to which they may be reduced by valley-glacier abrasion. Although the outwash is covered by saline water at high tide, fresh water flows out at low tide, showing that the sediment-water relationship is dynamic and that glacial meltwater is now flowing through the outwash.—*from* Authors' abstract

03830 **Slaughter, Bob H.** Earliest known marsupials: Science, v. 162, no. 3850, p. 254–255, illus., 1968.

The infraclass Metatheria has not been reported from deposits pre-dating the mid-Cretaceous. Fossil material just recovered from Albian deposits in north-central Texas has definite characteristics of the family Didelphidae and is submitted as being from the oldest known marsupials. The same locality has also produced remains referable to Eutheria, demonstrating a somewhat earlier divergence of these two important groups than was known before.—Author's abstract

Slavin, Walter. *See* Manning, David C. 03291

03540 **Smalley, I. J.; Vita-Finzi, C.** The formation of fine particles in sandy deserts and the nature of 'desert' loess: Jour. Sed. Petrology, v. 38, no. 3, p. 766–774, illus., 1968.

There are no loess deposits within sandy desert areas, but they may occur at the desert margins. The major loess provinces to which a desert origin has been ascribed either are not true loess or are explicable in terms of glacial origin. Desert loess deposits should be distinguishable from glacial loess deposits by their size and their mineralogical nature. Stresses produced by temperature changes can break rocks provided that the rock particles are not below a critical size. Most quartz is introduced into the sedimentary system as sand-size particles (about 500μ); if the critical thermal break size is above 500μ, then the thermal breakage process will not produce loess-sized particles.—*from* Authors' abstract

03900 **Smith, A. Gilbert.** The origin and deformation of some "molar-tooth" structures in the Precambrian Belt-Purcell Supergroup: Jour. Geology, v. 76, no. 4, p. 426–443, illus., tables, 1968.

Molar-tooth structures are calcite plates or systems of united plates, originally mainly perpendicular to bedding, that have been deformed by compaction of the enclosing sediments. The available evidence suggests that the calcite plates were precipitated by algae in water-rich silt and silty clay, and were crumpled by penecontemporaneous compaction at depths of less than 1.3 below the sedimentary interface.—ETR

Smith, A. Gilbert. *See* Funnell, B. M. 03927

Smith, J. V. *See* Bennett, J. M. 03722

03776 **Smith, Patsy B.** Paleoenvironment of phosphate-bearing Monterey Shale in Salinas Valley, California: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1785–1791, illus., tables, 1968.

In two measured sections through the Monterey Shale, one in the west-central and one in the southeast part of the valley, the early and early middle Miocene rocks contain Foraminifera faunas indicating bathyal (4,000± ft) water depth. Above this, in the late middle Miocene rocks that include the pelletal phosphorites, the faunas indicate shallow water (150± ft). The very siliceous rocks, thought to be formed by alteration of thick diatomite deposits, indicate deposition in conditions of upwelling nutrient-rich waters.—*from* Author's abstract

03563 **Smith, Stephen V.; Utley, Ronald W.** Froth flotation for impure carbonate sediments: Jour. Sed. Petrology, v. 38, no. 2, p. 664–665, illus., table, 1968.

Froth flotation is a satisfactory method for upgrading the carbonate content of sediments.—Authors' abstract

03828 **Snow, David T.** Hydraulic character of fractured metamorphic rocks of the Front Range and implications to the Rocky Mountain Arsenal well, *in* Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well, Pt. A: Colorado School Mines Quart., v. 63, no. 1, p. 167–199, illus., 1968.

Hydraulic and geometric properties of fractured metamorphic rocks of the Front Range of Colorado are determined from damsite pressure-injection tests and records of water wells. Beneath the Denver basin these rocks comprise the reservoir into which fluid wastes have been injected. At damsites in the Front Range metamorphic rocks, fracture spacing is about 5–10 feet near the surface, increasing to about 15–35 feet at the 200-ft level. Openings close from about 200 μ to about 70 μ between the near-surface and 200-ft depth and porosities decrease from about .04 to .001 percent. Test data suggest that the aquifer is bounded by vanishing permeability at about 200 feet. Pre-Pennsylvanian soils and sediments resting on gneiss at the well site may effectively confine flow to the fractured basement.—*from* Author's abstract

03875 **Snow, David T.** Fracture deformation and changes of permeability and storage upon changes of fluid pressure, *in* Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well, Pt. A: Colorado School Mines Quart., v. 63, no. 1, p. 201–244, illus., 1968.

Fractures are nonrigid fluid conductors so small that opening changes with pressure changes result in permeability changes and account for storativity. Plane vertical strain is assumed in derivation of transient flow equation, but in radial cases such as Rocky Mtn. Arsenal well injection, stress, permeability, and hydraulic potential distributions are interrelated. A deformability coefficient for fractures in Front Range metamorphic rocks at Bergen Park, is deduced from strain measurements near a water-supply well draining the fracture system. Effective stress changes consequent to fluid-pressure changes may have significance to earthquake mechanism, especially if evidence points to a critical state of tectonic stress. From latest faulting in the Denver basin criticality may have been maintained by erosional release of confinement, suggesting fractured basement is prone to rock failure upon injection of fluids.—*from* Author's abstract

03726 **Snowden, Dervorguilla.** (compiler). Abstracts of publications in scientific journals by officers of the Geological Survey of Canada, April 1967 to March 1968: Canada Geol. Survey Paper 68-4, 67 p., 1968.

This report contains abstracts of 106 papers, arranged alphabetically according to author. Abstracts have been copied from the published texts or prepared by the authors concerned for this publication.—GDC

03720 **Spendlove, Earl.** When dinosaurs trod Utah's Vermilion Cliffs: Desert, v. 31, no. 8, p. 23–25, illus., 1968.

This article is a popular description of dinosaur tracks on the Vermilion Cliffs along the Arizona–Utah border.—KAF

Spinosa, Claude. *See* Furnish, W. M. 03636

03251 **Stanley, Daniel J.** Graded bedding–sole marking–graywacke assemblage and related sedimentary structures in some Carboniferous flood deposits, eastern Massachusetts, *in* Late Paleozoic and Mesozoic continental sedimentation, northeastern North America—A symposium: Geol. Soc. America Spec. Paper 106, p. 211–239, illus., 1968.

Detailed study of the Pennsylvanian Wamsutta Formation illustrates that similar processes of sedimentation active in entirely different environments can produce similar assemblages of sedimentary structures. South of Boston diverse structures are available and the nonmarine and alluvial origin of the Wamsutta has been established. Sedimentary properties observed at this locality are comparable to present-day overbank flood-plain deposits; most prominent are repetitive sequences of mud-cracked horizons within red sandstone sheets, and abundant scour-and-fill and channel bodies. The Wamsutta also displays features similar to those of turbidites, flysch, and eugeosynclinal deposits, as well as closely spaced graywacke beds with sole markings. Floods and turbidity currents have much in common, the resulting beds graded vertically and also laterally.—GDC

Stearns, Richard G. *See* Wilson, Charles W., Jr. 03705

03706 **Stearns, Richard G.; Tiedemann, Herbert A.; Wilson, Charles W., Jr.** Geologic map of the Needmore quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 38–NE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Needmore quadrangle, Tennessee," by C. W. Wilson, Jr., R. H. Barnes, and H. A. Tiedemann is cited separately.—MCM

03707 **Stearns, Richard G.; Tiedemann, Herbert A.; Wilson, Charles W., Jr.** Geologic map of the Erin quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 38–SW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Erin quadrangle, Tennessee," by C. W. Wilson, Jr. and H. A. Tiedemann is cited separately.—MCM

Stearns, Richard G. *See* Ferguson, Carl C. 03708

Štelcl, Otakar. *See* Panoš, Vladimír. 03754

03486 **Stephenson, Eugene A.** Estimation of natural gas reserves, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 2046–2103, illus., tables, 1968.

All estimates of reserves depend upon certain basic scientific principles, of which Boyle's law is fundamental, though not rigidly applicable to natural gases; a correction for deviation is required. Several methods of estimation are described herein, and illustrated with equations, diagrams, and maps. Methods are: (1) Volumetric or porosity–pressure method, based on sand thickness, pressure factors, and area. (2) Pressure–production decline method. (3) Changes in density of gas during production. (4) Associated or solution gas–cap method. (5) Comparison between fields. Condensate reservoirs and reservoirs under water drive offer particular problems. Other considerations that must be taken into account in estimating gas reserves are operation losses, compressibility of liquids, and availability of gas reserves.—Author's abstract

03809 **Sternberg, R. W.** Friction factors in the tidal channels with differing bed roughness: Marine Geology, v. 6, no. 3, p. 243–260, illus., tables, 1968.

During an investigation of six tidal channels in Puget Sound, Wash., and the Strait of Juan de Fuca, measurements were made of velocity distribution, bed

configuration, and sediment textural characteristics of each channel. Basic descriptions are tabulated. Bed configuration varied from rocks and gravel to small ripples and sand deformed into irregular roughness patterns. Velocity data were collected continuously for periods of several to 20 hours. The boundary between transitional and rough flow seems to be qualitatively related to the geometry of the bed, the more complex beds becoming fully rough at higher Reynolds number than more simple roughness patterns. By grouping all data, a mean and 96 percent confidence limit was assigned to the drag coefficient, which represents an average value for the shallow marine environment regardless of bed configuration and flow conditions. Established sediment motion was not observed.—GDC

03837 **Stewart, John H.; Albers, John P.; Poole, Forrest G.** Summary of regional evidence for right-lateral displacement in the western Great Basin: Geol. Soc. America Bull., v. 79, no. 10, p. 1407–1413, illus., table, 1968.

Right-lateral displacement of 80 to 120 miles across the western Great Basin is indicated by the consistent disruption of sedimentary facies and thickness trends of formations ranging in age from late Precambrian to Mesozoic. Some of this displacement occurs as fault slip and some as a more pervasive large-scale drag (oroflexural bending).—Authors' abstract

Stockard, Henry. *See* Drake, Charles L. 03643

Stockton, C. A. *See* Frei, R. W. 03249

03578 **Stokes, William Lee.** Multiple parallel-truncation bedding planes—A feature of wind-deposited sandstone formations: Jour. Sed. Petrology, v. 38, no. 2, p. 510–515, illus., 1968.

Many extensive, smooth, parallel surfaces suggesting water action occur in the blanket sandstone formations with eolian crossbedding of the Colorado Plateau. These planes sharply truncate crossbedding and obviously cannot be of depositional origin; much material has been removed in forming them. The name multiple parallel-truncation bedding planes is proposed. Examples are seen in the Entrada, Navajo, Wingate, De Chelly, and Coconino Sandstones. It is supposed that conditions were frequently such that previously accumulated sand was removed down to the water table, creating the smooth surfaces which now separate intervals of crossbedded sandstone. This process is to be expected in interior basins. Windswept, saturated surfaces such as the Great Salt Lake Desert show similar leveling effects, but here the water table is falling so a stratigraphic record is not preserved.—*from* Author's abstract

03861 **Stokes, William Lee.** Primary current lineation or parting lineation?: Geol. Soc. America Bull., v. 79, no. 10, p. 1419–1420, 1968.

The terms "primary current lineation" and "parting lineation" have both been applied to the same depositional feature of sedimentary rocks. It is agreed that the origin is a streamlining effect on loose sand grains parallel with current direction. A superficially similar effect is seen on parting planes of certain metamorphic rocks and is due to the intersection of s-surfaces. This lineation is at right angles to the tectonic movement. It is suggested that the term "primary current lineation" be retained for the sedimentary depositional feature to avoid confusion with the lineation imposed by movement within metamorphic rocks.—*from* Author's abstract

Stone, Ronald W. *See* Woodriff, Ray. 03310

Strangway, D. W. *See* Larson, E. E. 03912

03916 **Strangway, D. W.; Honea, R. M.; McMahon, B. E.; Larson, E. E.** The magnetic properties of naturally occurring goethite: Royal Astron. Soc. Geophys. Jour., v. 15, no. 5, p. 345–359, illus., tables, 1968.

Goethite acquires a thermoremanent magnetization (TRM) when cooled in the presence of a magnetic field from 120°C, due to the presence of antiferromagnetism with a Néel temperature of 120°C. A few spins have no mates because of small

grain size or the presence of imperfections and impurities. Similarly, hematite acquires a TRM at Néel temperature which is due to unbalanced spins, and in addition it has a "parasitic ferromagnetism." Hematite derived from heating goethite above 350°C showed two different types of behavior. That composed of particles less than 0.5μ diameter showed no spontaneous magnetization but did show weak thermoremanence, whereas hematite composed of larger particles developed a spontaneous magnetization. Thus parasitic ferromagnetism must exist only in grains larger than 0.5μ.—DBV

03637 **Strimple, H. L.** A new edrioasteroid: Iowa Acad. Sci. Proc. 1966, v. 73, p. 260–262, illus., 1968.

Two specimens of an edrioasteroid in excellent preservation have been found in the Pella beds, Upper Mississippian, by Amel Priest of Peru, Iowa at an abandoned quarry northeast of Knoxville, Marion County, Iowa. The interior of the theca is exposed in the smaller specimen and the existence of a stone canal is disclosed. The species is described as *Discocystis priesti*, new species.—Author's abstract

Strimple, Harrell L. *See* Koch, Donald L. 03655

03300 **Strock, Lester W.** Thirty years of development of dc arc spectrochemical analysis methods [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 364, 1968.

Stroyev, P. A. *See* Gaynanov, A. G. 03817

03677 **Strum, Rolland G.; Kaarsberg, Ernest A.** Geophysical Exploratory Manned Mobile Submersible (GEMMS)—[Pt. 1], Exploratory submersible for the future: Ocean Industry, v. 3, no. 8, p. 50–55, illus., 1968.

The deep-sea GEMMS, Geophysical Exploration Manned Mobile Submersible, a polyhedral glass slab command unit, carries a crew of four. GEMMS is capable of working at 15,000 feet, is nonmetallic and nonmagnetic, and can lift 30 tons. Two-thirds of the ocean floor could be explored at this depth. The crew has an extended, unbroken, and undistorted panoramic view of the sea floor and can carry out activities in connection with geodetic, geologic, geophysical and other earth-science measurements.—ESL

03695 **Sumsion, Carlton T.** Summary of the geology and ground-water resources of Pitt County, North Carolina: U.S. Geol. Survey Hydrol Inv. Atlas HA-291, scale 1:125,000, text, 1968.

Ground water occurs in unconsolidated sediments that overlie an eastward-sloping erosional surface of the basement metamorphic-rock complex analogous to that exposed in the Piedmont province to the west. The basement complex is not an aquifer in Pitt County. The sedimentary sequence ranges in thickness from about 300 to nearly 1,200 feet; penetrated sediments range from Lower Cretaceous to post-Miocene in age. Aquifers within the sediments are in reality aquifer systems, consisting of more than one water-yielding sand layer separated by layers of semipermeable silts and clays. Beneath the shallow unconfined water-table aquifer, seven artesian or confined aquifer systems are here defined; their depth and extent are shown on the map and sections, with quality from selected wells tabulated in the chemical analyses. Utilization of ground water has a large potential, but remains relatively undeveloped.—MCM

Swenson, R. E. *See* McCrae, R. O. 03469

03901 **Swift, Donald J. P.** Coastal erosion and transgressive stratigraphy: Jour. Geology, v. 76, no. 4, p. 444–456, illus., 1968.

Unconformities of transgressive sequences, called ravinements, commonly separate the basal beds of the sequences from the overlying marine sands. The ravinements are cut mainly by surf action along a narrow zone at the foot of the shore face, and are generally present in both erosional and depositional transgressive situations. Ravinement depends on tide range, intensity and direction of wave attack, rate of sediment supply, nature of the sediment, and relative rate of sea rise. The ravinement

process fails to operate only when the shore face is mantled with lag. Examples are given from Nova Scotia and North Carolina.—ETR

Syers, J. K. *See* Roth, C. B. 03805

03933 **Syers, J. K.; Chapman, S. L.; Jackson, M. L.; Rex, R. W.; Clayton, R. N.** Quartz isolation from rocks, sediments and soils for the determination of oxygen isotopes composition: Geochim. et Cosmochim. Acta, v. 32, no. 9, p. 1022–1025, illus., 1968.

Fusion of ground samples of rocks, sediments, and soils with sodium pyrosulfate removed most of the minerals except quartz and feldspars. Treatment of the residue with hydrofluosilicic acid completely removed feldspars. Quartz thus isolated, with 0-18:0-16 ratio unchanged, is suitable for isotopic analysis.—Authors' abstract

03792 **Sykes, C. Ronald.** Mineral resources summary of the Hebron quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 9 p., 1968.

All mapped units of the Hebron quadrangle contain sand, but the Claiborne is the most satisfactory source of sand and gravel; all but one of the 19 pits are in the Claiborne. The material is used locally for road construction. Although no clay has been mined, the Wilcox and Porters Creek Formations have been prospected or examined and it is possible that some clay would be suitable for several purposes. Sparse heavy minerals occurring locally in Claiborne sands are not of economic importance. This summary accompanies Tennessee Div. Geology Geol. Map GM 440-NW by W. S. Parks (cited separately).—MCM

03288 **Syty, Augusta; Dean, John A.** Determination of phosphorus and sulfur in shielded and unshielded fuel-rich air-hydrogen flames [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 361, 1968.

03877 **Szalay, Frederick S.** The Picrodontidae, a family of early primates: Am. Mus. Novitates, no. 2329, 55 p., illus., tables, 1968.

The Picrodontidae family of Paleocene mammals is known only from North America. A detailed study of new material from the Torrejonian Swain Quarry, Carbon County, Wyoming, and of the collections made in the past from Silberling and Gidley quarries, Sweet Grass County, Montana, unequivocally points to derivation from paromomyine prosimians, at some time during the Puercan. Changes in mastication, occlusion and evolutionary trends of Picrodontidae emphasize the stringent requirements that occlusion imposes on the manner of morphological and functional change in mammalian molars.—KAF

Tailleur, I. L. *See* Gryc, George. 03799

Takayanagi, Yokichi. *See* Asano, Kiyoshi. 03815

03504 **Takken, Suzanne.** Subsurface geology of North Gotebo area, Kiowa and Washita Counties, Oklahoma, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1492–1508, illus., 1968.

The area is on the north flank of the subsurface expression of the Wichita Mountains and is characterized by thrust faulting, overturned folds, and upside-down producing sands. The main fault, the "Gotebo fault", dips to the south, and Silurian-Devonian Hunton rocks lie upon Mississippian rocks. Permian rocks overlie the entire area. North Gotebo is principally a gas field, but oil also is produced from Springer sands. The Gotebo thrust, or one like it, can be traced for several miles in either direction from the North Gotebo production. It is probable that similar geologic conditions are present adjacent to any mountain complex, particularly where beds are relatively incompetent.—*from* Author's abstract

Talbot, J. L. *See* Hobbs, B. H. 03907

Tandon, H. L. S. *See* Kurtz, L. T. 03259

03462 **Tanner, W. F.; Williams, G. K.** Model diapirs, plasticity, and tension, *in* Diapirism and diapirs—A symposium: Am. Assoc. Petroleum Geologists Mem. 8, p. 10–15, illus., 1968.

Models, showing the relations between diapirs and regional stress, with a length ratio of 10^{+6} to 10^{-6} were designed to develop domes and ridges much like those under the Gulf of Mexico. This happened when tensional deformation and sedimentation were simultaneous; they did not appear readily in other models. Grabens also formed at the surface. Normal faults were the main type produced, and ridges paralleled the grabens. The model ratio of viscosity was not satisfactory. The models strongly suggest that a field of domes and(or) ridges is a corollary of regional tension, and that source-bed plasticity rather than density differences is the critical parameter.—HRC

Taylor, Francis R. *See* Campbell, Clement. 03306

03586 **Taylor, Landon C.; Wilson, Charles W., Jr.** Mineral resources summary of the Baxter quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 5 p., 1968.

Mineral resources mined in the Baxter quadrangle are limestone and gravel. Several limestone formations are exposed, of which the Bigby–Cannon is best suited for most general uses. Chert gravel for use as road material occurs in flood plains and beds of streams and is of potential economic importance. This text accompanies Tennessee Div. Geology Geol. Map GM 326-NW by R. H. Barnes and C. W. Wilson, Jr. (cited separately).—MCM

03587 **Taylor, Landon C.; Wilson, Charles W., Jr.** Mineral resources summary of the Cookeville West quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 11 p., table, 1968.

The only mined resource in the Cookeville West quadrangle is limestone, mainly from the Monteagle and St. Louis Formations. Potential resources are chert gravel in flood plains and stream beds, and chert in residual material from the Fort Payne Formation. This summary accompanies Tennessee Div. Geology Geol. Map GM 326-NE by C. W. Wilson, Jr. and M. V. Marcher (cited separately).—MCM

03588 **Taylor, Landon C.; Wilson, Charles W., Jr.** Mineral resources summary of the Hilham quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 18 p., table, 1968.

Mineral resources mined in the Hilham quadrangle are limestone, mainly from the Monteagle and St. Louis Limestones, and sandstone from the Hartselle Formation. Of the 34 test wells drilled for oil and gas, 10 have produced commercial quantities of oil and one well is still producing. Shows of oil and gas have been reported in the Trenton Group; oil production and shows have been in the Stones River Group. This text accompanies Tennessee Div. Geology Geol. Map GM 330-NW, by C. W. Wilson, Jr., and J. M. Colvin, Jr. (cited separately).—MCM

03812 **Taylor, Patrick; Zietz, Isidore; Dennis, Leonard S.** Geologic implications of aeromagnetic data for the eastern continental margin of the United States: Geophysics, v. 33, no. 5, p. 755–780, illus., 1968.

An aeromagnetic survey from the Gulf of Maine to the tip of Florida was conducted in 1964–66. The residual aeromagnetic map shows a continuous magnetic high on or near the continental slope as far south as the 31st parallel. At about the 36th parallel, this anomaly splits into two branches. At the 31st parallel the outer branch swings westward and crosses the coastline near Brunswick, Ga. This continuous magnetic anomaly may result from an igneous intrusive body that parallels the edge of the pre-Paleozoic continental landmass, and suggests that Florida and part of Georgia were added to the paleo-continent in pre-Paleozoic time. Landward from the east-coast anomaly the magnetic field is quite variable, whereas oceanward it has an extremely small gradient. The absence of magnetic anomalies east of the

continental slope suggests that in this region layer 2 may be composed of metamorphosed basalt.—*from* Authors' abstract

03719 **Taylor, R. E.; Berger, Rainer; Dimsdale, B.** Electronic data processing for radiocarbon dates: Am. Antiquity, v. 33, no. 2, p. 180–184, illus., table, 1968.

The need for a more flexible index for radiocarbon dates with shorter retrieval times has led to a suggestion for the development of an electronic or punch card data retrieval system. A suggested format for coding radiocarbon data on punch cards and two techniques for rapid retrieval of desired information are discussed.—Authors' abstract

Teague, Norman P. *See* Pollard, Jack C. 03869

Thomas, R. A. *See* Bailey, C. A. 03322

Thompson, Robert W. *See* Walker, Theodore R. 03897

Thorpe, R. I. *See* Harris, D. C. 03820

Tiedemann, Herbert A. *See* Wilson, Charles W., Jr. 03579

Tiedemann, Herbert A. *See* Wilson, Charles W., Jr. 03582

Tiedemann, Herbert A. *See* Wilson, Charles W., Jr. 03583

Tiedemann, Herbert A. *See* Wilson, Charles W., Jr. 03705

Tiedemann, Herbert A. *See* Stearns, Richard G. 03706

Tiedemann, Herbert A. *See* Stearns, Richard G. 03707

03735 **Tilley, Philip.** Early challenges to Davis' concept of the cycle of erosion: Prof. Geographer, v. 20, no. 4, p. 265–269, 1968.

As an example of "persistent error" in scientific thinking, it is shown that through lack of "continuous dialogue" between workers, the early challenges of Hettner, Passarge, and others to Davis' concept of the cycle of erosion had relatively little influence. Errors will continue to be propounded unknowingly if recognition is not made of earlier studies and there is no critical reaction to preceding and contemporary challenges.—LLR

03634 **Tinoco, Fernando H.; Handy, Richard L.; Hoover, James M.** Void ratio and shear strength of two compacted crushed stones: Iowa Acad. Sci. Proc. 1966, v. 73, p. 219–233, illus., tables, 1968.

Triaxial compression tests of two crushed limestones of differing highway service records indicate a fundamental difference in their shear strength–void ratio relationship. The better service record sample compacted to higher density, and had a high effective angle of internal friction and zero effective cohesion. The other sample compacted to lower density and had a lower friction angle, but gained significant stability from effective cohesion. Repeated loading–unloading cycles reduced the cohesion, apparently due to modification of the sample structure. Extrapolations of the results to zero void ratio agree with sliding friction data reported on calcite, or with triaxial parameters reported on carbonate rocks.—*from* Authors' abstract

Tippett, M. C. *See* Sayers, R. W. 03848

03660 **Todd, Ruth.** Recent literature on the Foraminifera: Cushman Found. Foram. Research Contr., v. 19, pt. 3, p. 123–130, 1968.

About 145 entries, all annotated, are given in the bibliography.—ESL

03545 **Todd, Thomas W.** Paleoclimatology and the relative stability of feldspar minerals under atmospheric conditions: Jour. Sed. Petrology, v. 38, no. 3, p. 832–844, illus., table, 1968.

Details from the study of clay and feldspar minerals in the Domengine sandstone, Eocene, and the Modelo sandstone, Miocene, of California are presented. The study supports the contention that under favorable circumstances, gross climatological characteristics of ancient terranes can be induced from mineralogical evidence. Classical methods of establishing the stability of minerals under soil-weathering conditions is inadequate because: (1) the effects of structural details of the host minerals on weathering reaction rates have not been given sufficient consideration; (2) direct host–guest mineral relations have not been established, with the result that inhibitory or accelerative effects of metastable weathering products on host degradation are unclear; (3) micrometeorological influence on the chemical environment at grain boundaries has not been carefully investigated.—*from* Author's abstract

03550 **Todd, Thomas W.** Dynamic diversion—Influence of longshore current–tidal flow interaction on chenier and barrier island plains: Jour. Sed. Petrology, v. 38, no. 3, p. 734–746, illus., 1968.

A correlation has been established in the vicinity of the Mississippi River delta, by means of radiocarbon dating, between the low rate of sediment discharge into westward moving longshore currents, stability or minor recession of the downdrift shoreline, and slow accretion of well-sorted chenier beach ridge sand. Barrier island plains closely resemble chenier plains except that barrier island beach ridges are separated by clayey, silty, poorly-sorted fine sand, and chenier ridges are separated by unsorted, sandy, shoreface mud deposits. A close geographic association invariably exists between chenier deposits and river or estuary mouths, although cheniers do not always receive sediments from adjacent rivers; dynamic diversion, a complex interaction between longshore currents and tidal flow, causes the material to bypass the chenier and settle farther downdrift.—*from* Author's abstract

03506 **Totten, Robert B.; Horn, Paul H.** Introduction to regional geology and typical gas fields of western Anadarko basin, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1525–1538, illus., 1968.

The Texas and Oklahoma Panhandle areas encompass a vast area of stratigraphic and structural entrapment for gas and oil, principally gas. Significant reserves and production have been found continuously since 1918 and there should be no decrease in activity in the foreseeable future. The Anadarko basin, defined on the south by the buried Amarillo mountains and on the west by the Cimarron uplift, and rising into the shallow Hugoton embayment on the north, received a flood of sediments in the Pennsylvanian which provided the principal reservoir rocks. Morrow, Virgil, and Missouri rocks are the most important producing units. Authors' abstract

03854 **Towe, Kenneth M.; Rützler, Klaus.** Lepidocrocite iron mineralization in keratose sponge granules: Science, v. 162, no. 3850, p. 268–269, illus., table, 1968.

Reddish-brown granules embedded in the spongin fibers of some keratose sponges consist of very fine crystallites of poorly organized lepidocrocite, $\gamma FeOOH$. This is the first occurrence of crystalline iron mineralization in the phylum Porifera and the first indication of hard tissue formation among the Keratosa. Such organisms may contribute small quantities of iron oxides and their diagenetic alteration products to adjacent sediment.—Authors' abstract

03742 **Townsend, Robert.** Exploring Pinacate: Desert, v. 31, no. 5, p. 30–31, illus., 1968.

The author briefly describes ten volcanic craters in the Pinacate Mountains of northwestern Sonora, Mexico.—KAF

Trautman, Milton A. *See* Buckley, James D. 03794

Trautz, Otto R. *See* LeGeros, Racquel Z. 03324

Trautz, Otto R. *See* Klein, Edward. 03325

03522 **Trojer, Felix J.** Crystal structure of a high-pressure polymorph of $CaSiO_3$: Naturwissenschaften, v. 55, no. 9, p. 442, 1968.

The material was made by R. D. Shannon from $CaSiO_3$ glass at 65 kilobars. The space group is $P\bar{1}$, $Z=6$. The main feature of the structure is Si_3O_9 rings sandwiched by layers of three different Ca atoms, two of which have an octahedral coordination, and the third, eight-fold; these coordinates are tabulated.—ESL

03932 **Truesdell, A. H.; Hostetler, P. B.** Dissociation constants of KSO_4^- from 10°-50°C: Geochim. et Cosmochim. Acta, v. 32, no. 9, p. 1019-1022, illus., table, 1968.

A cell without liquid junction was used to obtain dissociation constants for the reaction: $KSO_4^- = K^+ + SO_4^{2-}$. At 10°, 25°, 38° and 50°C, values for K_{diss} KSO_4^- are, respectively, 0.19_5, 0.14_2, 0.11_7, and 0.09_5. At 25°C, ΔGf and $\Delta Hf°$ values for the KSO_4^- ion are -245.96 and -274.02 kcal per mole, and S° is +42.3 cal per mole per deg.—Authors' abstract

03650 **Trusell, Fred C.; McKenzie, William F.** Spectrophotometric determination of copper: Anal. Chim. Acta, v. 40, no. 2, p. 350-351, table, 1968.

DMDPQ, 6,7-dimethyl-2,3-di(2-pyridyl)quinoxaline, was found to be a suitable colorimetric reagent for copper, being remarkably selective and subject to few interferences.—ESL

03891 **Tucker, Delos R.** Lower Cretaceous geology, northwestern Karnes County: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 820-851, illus., 1968.

Most of the 5,000 feet of Lower Cretaceous sediments in Karnes County consist of two dolomitic limestone bodies, which were deposited in backreef provinces of two barrier reef complexes. Each is overlain by a blanket-type deposit of impermeable shale and shaly limestone. Hydrocarbon accumulations are found in the upper limestone, but not the lower. The history of sedimentation, tilting, faulting, and hydrocarbon accumulation is discussed. The "potential void" concept is used to explain faulting in the area. The stratigraphic term "format" is proposed as a formal name for bed-bounded sequences of sedimentary rocks. The use of histograms, scatter diagrams, and thickness ratios in petroleum exploration is illustrated.—WCC

03635 **Tucker, M. M. Riddler.** Preliminary study of some Wyoming Paleozoic carbonates: Iowa Acad. Sci. Proc. 1966, v. 73, p. 234-252, illus., tables, 1968.

Thin section studies of Paleozoic carbonates from the Wind River Range, Wyoming, reveal various fabrics and diagenetic alteration. The limestones and dolostones are from five principal units: the Gros Ventre, Gallatin, Bighorn, Darby, and Madison Formations. First, it has been found that rather uniform depositional conditions must have existed on this shelf with a decrease in depositional energy at or near the tops and/or bottoms of each system. Secondly, there appears to be a relatively strong correlation between secondary dolomite and non-carbonate material in these sediments which may or may not be indicative of an unstable shelf environment. Finally, Robert L. Folk (1959) has made several conclusions about the relative abundance of principal constituents in carbonate rocks; his opinions have been substantiated by this study.—*from* Author's abstract

03525 **Tulsa University.** Exploration and production thesaurus (3d edition): Tulsa, Okla., University of Tulsa, Inf. Services Dept., 260 p., 1968; originally published 1965.

The main purpose of this listing of scientific and engineering terms and their relations is for use in vocabulary control in indexing and retrieving PETROLEUM

ABSTRACTS. The volume covers the subject areas of geology, geochemistry, geophysics, well logging, well completion and servicing, production of oil and gas, engineering and recovery methods, pipelining, shipping and storage, and supplemental technology. The hierarchy is based on the concept-oriented (faceted) principle. A complete outline of the hierarchy and an alphabetical index to the hierarchy are included at the end of the main thesaurus.—MCM

03513 **Turner, Daniel S.** Natural gas in Black Mesa basin, northeastern Arizona, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1357–1370, illus., tables, 1968.

A total of 97 wells has been drilled in the Black Mesa basin of Arizona—a drilling density of one test per 350 sq mi. Exploration started in 1920 and was slow until 1955, when interest was stimulated by discoveries in the Four Corners area. In an unusually large percentage of all tests, shows of oil or gas have been found throughout the stratigraphic succession. Cretaceous to Cambrian Systems, except Silurian and Ordovician, are represented. The Pennsylvanian Hermosa Formation is productive in the Four Corners area. The Permian Coconino Sandstone yields helium, nitrogen, and carbon dioxide in the Pinta dome area near Holbrook. Rocks of reef facies and traps of the stratigraphic type may have hydrocarbon potential.—Author's abstract

03780 **Uchupi, Elazar; Emery, K. O.** Structure of continental margin off Gulf Coast of United States: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 7, p. 1162–1193, illus., 1968.

Evidence from continuous seismic-reflection profiles indicates that the steep slope off Florida and Yucatan were formed by construction of coral or algal reefs during the Cretaceous period. The upper continental slope and the shelf were formed by prograding and upbuilding of largely calcareous sediments off Florida and Yucatan, and of terrigenous sediments off Louisiana, Texas, and part of Mexico. The general structure off Louisiana and Texas was considerably altered by contemporaneous intrusion of salt diapirs.—WCC

03716 **Urey, Harold C.** The origin of some meteorites from the Moon: Naturwissenschaften, v. 55, no. 2, p. 49–57, illus., table, 1968.

The type I carbonaceous chondrites have a composition and microscopic structure consistent with an origin from the bed of a primitive lake. The maria of the Moon could have been primitive lake beds. The other carbonaceous chondrites are mixtures of type I material and other chondritic material: they may have been mixed on the surface of the same planetary body. Other chondrites may have come from different asteroids, from the Moon and Mars, or from the Moon and asteroids.—DBV

03896 **U.S. Air Force.** (Aeronaut. Chart and Inf. Center, compiler). Transcontinental geophysical survey (35°–39° N.)—Bouguer gravity map from 74° to 87° W. longitude: U.S. Geol. Survey Misc. Geol. Inv. Map I-535-B, scale 1:1,000,000, 1968.

Utley, Ronald W. *See* Smith, Stephen V. 03563

03520 **Vand, V.; Johnson, G. G., Jr.** Indexing of X-ray powder patterns—Pt. 1, The theory of the triclinic case: Acta Cryst., v. A24, pt. 5, p. 543–546, 1968.

In a triclinic system, the squares of reciprocal spacings of any seven linearly independent X-ray powder lines which belong to the same lattice fulfill a Diophantine equation containing their Miller indices, which involves a 7×7 determinant. This can be expanded in minors which are integers. Theory is developed which breaks the problem of solving this equation into smaller steps, more easily amenable to numerical evaluation. The triclinic case has not yet been tried on a practical example, but the method already has been used in practice for systems of higher symmetry, for which the computational labor is much reduced.—Authors' abstract

03930 **vandeLindt, W. J.** Reply [to criticism by R. J. O'Connell, 1968, of "Movement of the Mohorovicic discontinuity under isostatic conditions" (1967)]: Jour. Geophys. Research, v. 73, no. 20, p. 6607, illus., 1968.

Answering the criticism of O'Connell (ibid., p. 6604–6607), van de Lindt points out that the deviation of his model (ibid., v. 72, p. 1289–1297, 1967) from McDonald and Ness model C was due to some incorrect values shown in a table and also because the sedimentation process was handled differently. There is only one point of intersection between the Clapeyron curve and the temperature curve, so that the problem of having two phase boundaries does not exist. A correction is made to the last equation. For the model chosen and within the range of parameters investigated, the velocity of the M-discontinuity is relatively insensitive to changes in latent heat or to the slope of the Clapeyron curve; it was not claimed that this is true for all models or for all ranges of parameters.—DBV

03608 **VanLoan, Paul R.** A new iron-titanium oxide mineral from Hearst, Ontario [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 581, 1968.

03648 **VanLoon, J. C.; Parissis, C. M.; Kingston, P. W.** Analysis of very small samples of sulfide minerals: Anal. Chim. Acta, v. 40, no. 2, p. 334–338, tables, 1968.

A tin-hydrochloric acid dissolution procedure together with the methylene blue colorimetric reaction are adapted to allow determination of sulfur in microgram or milligram sulfide samples. Atomic absorption is applied to the pot liquids to analyze metals. Sulfur recovery from eight minerals is tabulated.—ESL

03494 **Vary, J. A.; Elenbaas, J. R.; Johnson, M. A.** Gas in Michigan basin, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1761–1797, illus., tables, 1968.

Gas has been recovered in Michigan from rocks of Ordovician to Mississippian age, although much more is imported, as demands are high. Underground storage is an important aspect of gas economy. Certain gas fields in Michigan have provided excellent underground storage reservoirs. Future gas reserves from within the state must come from areas and depths where there has been little or no exploratory drilling. Recent discoveries in the Trenton-Black River of south-central Michigan and the Salina-Niagara of southeastern Michigan have given impetus to the search for oil and gas in the State.—*from* Authors' abstract

Vasquez, J. *See* Plock, C. E. 03248

03317 **Vincent, H. A.** Activation analysis of fluorine in rocks and minerals [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 369–370, 1968.

03264 **Virgo, D.** Partition of strontium between coexisting K-feldspar and plagioclase in some metamorphic rocks: Jour. Geology, v. 76, no. 3, p. 331–346, illus., table, 1968.

The distribution coefficient (Kd) of strontium in coexisting feldspars, expressed as the ratio mole percent Sr-feldspar in K-feldspar/mole percent Sr-feldspar in plagioclase, is near 1.0 in amphibolite-facies rocks and near 1.5 in associated granulite-facies rocks from six different areas. Kd for most isofacial samples shows slight dispersion and is independent of the proportion of Kd to plagioclase, suggesting that feldspars attained equilibrium. Kd for feldspars, changing progressively, correlates with Kd of total Fe/Mg in coexisting clino- and ortho-pyroxenes, and with measured temperature dependence of Sr substitution in synthetic feldspars. Kd of feldspars is thus a qualitative geothermometer indicative of metamorphic grade.—BFL

03250 **Vita, O. A.; Levier, W. A.; Litteral, E.** Solvent extraction separations with BPHA—Applications to the microanalysis of niobium and zirconium in uranium [with French and German abs.]: Anal. Chim. Acta, v. 42, no. 1, p. 87–94, illus., table, 1968.

A detailed study of the benzoylphenylhydroxylamine–chloroform–hydrochloric acid solvent extraction system with 52 elements is described with emphasis placed on extraction of the easily hydrolyzed transition metals from strong hydrochloric acid. From this study, a separation procedure for hafnium, niobium, tantalum, titanium, vanadium, and zirconium from uranium was developed, and procedures are given for the microanalysis of niobium and zirconium in uranium. Niobium and zirconium are separated from uranium by extraction into BPHA–chloroform from 10 *N* Hcl. The separated elements are then measured colorimetrically as the niobium–4-(2-pyridylazo) resorcinol and zirconium–arsenazo III complexes. The limit of detection is 1μg/g U.—Authors' abstract

Vita-Finzi, C. *See* Smalley, I. J. 03540

03919 **Vollstadt, H.** On the determination of rock-magnetic parameters by differential thermal analysis: Royal Astron. Soc. Geophys. Jour., v. 16, no. 1, p. 71–77, illus., tables, 1968.

Thermodynamic considerations suggest the Curie temperature can be represented by means of differential thermal analysis. For this purpose, the heat capacity is used as parameter for the Curie-point range; the basic theoretical connections for this are reported. In passing, an account is given of some experimental results as well as of tests made to use magnetic substances with certain characteristic features instead of the usual inert ones.—Author's summary

vonFredersdorff, C. G. *See* Elliott, Martin A. 03476

03859 **Wagener, H. D.** On use of the term *equilibrium* in reference to magmatic crystallization: Geol. Soc. America Bull., v. 79, no. 10, p. 1405–1406, 1968.

Equilibration in the crystallization of deep-seated silicate melts is an idealized and often confusing concept. It is suggested that the petrologist's term "equilibrium crystallization," as applied to magmatic processes be replaced by "reversible crystallization," and that "irreversible crystallization" be used in place of "disequilibrium crystallization."—Author's abstract

03753 **Wagner, Oscar E., Jr.** Maps of Townships 20–29 North, Ranges 2 to 12 East, Osage County, Oklahoma: Washington, D.C., U.S. Bur. Indian Affairs, 17 sheets, scale about 1 in. to 1/2 mi., 1967–68.

Each map shows the subsurface structure of the top of the Oswego lime (Fort Scott limestone), the producing beds in oil and gas wells, and the deepest rocks penetrated in dry holes, as of August 31, 1967, December 31, 1967, or March 31, 1968.—MCM

Wahlgren, M. A. *See* Wing, James. 03316

03866 **Walker, C. T.** Evaluation of boron as a paleosalinity indicator and its application to offshore prospects: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 5, p. 751–766, illus., tables, 1968.

Equivalent boron content in illite is an indicator of paleosalinity. Suggestions that boron variation in illite is related to organic carbon or to the source are rejected. Paleosalinity measurements could help in correlations, in recognizing primary depositional features such as reefs and sand bars, and could lead to early recognition of the stratigraphic control of petroleum accumulations.—WCC

03897 **Walker, Theodore R.; Thompson, Robert W.** Late Quaternary geology of the San Felipe area, Baja California, Mexico: Jour. Geology, v. 76, no. 4, p. 479–485, illus., table, 1968.

Interfingered Pleistocene marine and nonmarine sediments near San Felipe, Mexico, including alluvial gravel, dune sand, beach deposits, intertidal mud, and evaporite, provide a record of shoreline transgression and regression. Stratigraphic and geomorphic relations of these deposits document the following sequence: (1) alluviation and pedimentation, (2) erosional transgression and arroyo cutting, (3)

depositional regression and arroyo filling during continued sea level rise, and (4) Holocene erosional transgression and arroyo cutting.—DRM

03694 **Waller, Roger M.; Feulner, Alvin J.; Morris, Donald A.** Water resources and surficial geology of the Homer area, south-central Alaska: U.S. Geol. Survey Hydrol. Inv. Atlas HA-187, scale 1:63,360, text, 1968.

The two maps on the sheet show surficial geology with locations of wells and springs, and water quality from selected surface and ground-water sources. Rocks ranging from the Tertiary Kenai Formation to Quaternary deposits are exposed within the three principal geomorphic units of the Homer area: the escarpment and adjacent upland, bench area at the foot of the escarpment, and the Homer Spit. The Kenai Formation probably constitutes the most extensive and most productive aquifer system. Yield of Quaternary deposits in glaciolacustrine areas of the lower bench is comparable to that of the Kenai. Glaciofluvial deposits underlying the Homer Spit area apparently do not contain fresh ground water. Ground water is typically of the sodium bicarbonate or calcium bicarbonate type, and locally contains as much as 30 ppm iron as well as combustible gas, probably from coal formations.—MCM

Walter, F. J. *See* Moore, B. J. 03321

03299 **Walters, J. P.** Thirty years of development of emission spectrochemical developments—The spark discharge [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 364, 1968.

03303 **Walters, J. P.** Excitation processes in a spark discharge [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 366, 1968.

03832 **Wang, Chi-Yuen.** Constitution of the lower mantle as evidenced from shock wave data for some rocks: Jour. Geophys. Research, v. 73, no. 20, p. 6459-6476, illus., tables, 1968.

The experimental Hugoniots of some geophysically interesting rocks in their high-pressure, dense forms are analyzed by a least-squares procedure to yield the densities of the "hot", metastable forms at zero pressure. If these dense forms represent homogeneous materials, their adiabatic equation of state may be computed to yield the bulk sound velocity at various compressions. The requirement that seismic velocity in the lower mantle should be matched leaves the dense form of dunite as a possible major constituent of the lower mantle. Comparison of zero pressure densities with the experimental results on phase transitions of a number of rock-forming minerals shows that the olivine → spinel transition predicts a density which supports Birch's postulate that silicates transform to closely packed simple oxides at very high pressure and temperature.—DBV

Ward, S. H. *See* Bodmer, René. 03814

03871 **Wardlaw, Norman C.** Carnallite-sylvite relationships in the Middle Devonian Prairie Evaporite Formation, Saskatchewan: Geol. Soc. America Bull., v. 79, no. 10, p. 1273-1294, illus., tables, 1968.

Abrupt lateral and vertical changes from red carnallitite (carnallite-halite rock) to red sylvinite (sylvite-halite rock) occur in the Prairie Evaporite Formation between Watrous and Kandahar, Saskatchewan. The distribution of trace bromide and rubidium in the chloride minerals indicates that red sylvinite was formed by leaching of magnesium chloride from carnallitite. This conclusion is substantiated by textural observations at carnallite-sylvite contacts, where red sylvite has replaced carnallite and inherited iron-oxide inclusions from carnallite. The amount of sylvite present corresponds to the amount which would be derived from carnallite by leaching on magnesium chloride. The potash zones are cumulatively about 50 feet thicker where they are red carnallitite than where they are red sylvinite.—*from* Author's abstract

03764 **Warner, David J.** Pleistocene Gastropoda of a lake deposit, Rimouski County, Quebec, Canada: Sterkiana, no. 31, p. 1-14, illus., tables, 1968.

The paleoecology of Lake No. 2 was reconstructed on the basis of a qualitative and quantitative study of 15 species of gastropods. The lake was never over four feet deep, and while vegetation was fairly abundant, the water was neutral to slightly alkaline. Fluctuations in the abundance of species as well as differences in sedimentation show that the lake fluctuated. The gastropods are only in the lower sediments of the lake. No glacial material is in the sediments so that the lake is probably postglacial.—HRC

Waterbury, G. R. *See* Hakkila, E. A. 03298

03740 **Watkins, N. D.** Comments on the interpretation of linear magnetic anomalies: Pure and Appl. Geophysics, v. 69, p. 179–192, illus., 1968.

In response to the recent interpretation of marine magnetic anomalies in terms of the crustal spreading hypothesis, a summary is made of other factors including structural, initial cooling, post cooling, and possible spontaneous processes which may cause at least some of the characters of linear magnetic anomalies. Arguments are developed by presentation of Q values for 571 specimens from 14 Icelandic lavas and six dikes, and by the Q value, stability factor, and oxidation variation between the cooling faces of one of these lavas. None of the processes described can alone readily account for the observed symmetry of magnetic anomalies with respect to mid-oceanic ridges, but they are presented to encourage examination and development of mechanisms other than geomagnetic polarity changes superimposed on a crustal generating system, as the causes of at least some oceanic magnetic anomalies.—Author's abstract

03914 **Watkins, N. D.** Reply [to discussion by Larson and Strangway of "Correlation of petrology and natural magnetic polarity in Columbia Plateau basalts" (1967)]: Royal Astron. Soc. Geophys. Jour., v. 15, no. 4, p. 433–437, illus., 1968.

Watkins summarizes and refutes each of Larson and Strangway's main points of criticism (ibid., p. 437–441); he does not debate the meaning of the correlations but comments on the poor logic used to refute the observations. The criticism is rejected because of inaccurate references, internal inconsistent arguments, subjectivity, and lack of quantitative approach. Larson and Strangway are clearly wrong in their assertion that the data do not exhibit a correlation between higher oxidation and increased percentage of reversed polarity specimens. They may well be correct if they imply that the data do not reflect a cause and effect relationship, but the reasoning they employ is insufficient to dismiss such a possibility.—DBV

03534 **Way, John Henry, Jr.** Bed thickness analysis of some Carboniferous fluvial sedimentary rocks near Joggins, Nova Scotia: Jour. Sed. Petrology, v. 38, no. 2, p. 424–433, illus., tables, 1968.

A fluvial origin in which meandering stream, backswamp, and floodplain environments formed fining-upward sequences is recognized in the Middle Carboniferous rocks. The sandstones are subarkosic and show little mineralogic variation. Bedding is uniformly thick, laterally persistent, and resembles the even-bedded alternation of sandstone and shale commonly found in flysch. Thickness distribution of beds tends to be log normal, indicating the possibility of a nearly complete history of fluvial deposition; whereas flysch beds commonly show truncated distributions suggesting erosion of the thinner units. Bedding characteristics, predominance of shale, and slope angle on a logarithmic plot of bed thickness at Joggins and four flysch sequences suggest that there may be similarities between fluvial deposition and subaqueous deposition.—*from* Author's abstract

03485 **Webb, J. B.; White, R. J.** C. Homeglen–Rimbey field, Alberta, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 2034–2036, 1968.

Homeglen–Rimbey is the southernmost in the chain of gas and oil fields extending south-southwest from Leduc. The gas comes from the Leduc reef formation. The field is about 12 miles long and generally two miles wide; the reef contains 552 feet of gas-pay rock. At the southern boundary of the field the regional dip of

the reef carries it below the gas/water interface; the reef continues farther to the south. The northward termination of the reef is very abrupt.—HRC

Weber, J. N. *See* Williams, E. G. 03577

Weimer, Robert J. *See* Hollister, John C. 03821

Weiss, Malcolm P. *See* Ali, Syed A. 03558

03333 **Wells, G. C.** Gas fields of the Alberta Foothills, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1229–1237, illus., 1968.

Nineteen gas fields and one oil and gas field had been discovered to the end of 1965. Mississippian strata constitute the principal reservoir rock; Triassic strata are important in two fields; Devonian strata provide the reservoir on one field, and are of minor importance in another. The gas fields of the Foothills are in overthrust fault structures, overthrust from the west and striking parallel with the mountains. Closure is afforded by the thrust fault on the east, the steeply dipping west flank, and the north and south plunges of the fault blocks. Subsurface structures generally are reflected at the surface by folds or imbricate fault zones, but seismic surveys normally are required to confirm dislocation in Paleozoic rocks, and to determine depths and configuration.—*from* Author's abstract

03774 **Wells, J. S.; Anderson, K. H.** Heavy oil in western Missouri: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1720–1731, illus., 1968.

Low-gravity, high-viscosity oil is present in discontinuous sandstone bodies at shallow depths in at least 21 western Missouri counties. Asphaltic sandstone beds are present from the lower Cherokee (Middle Pennsylvanian) section in Barton and Vernon Counties to the upper Pleasanton (Late Pennsylvanian) section in Lafayette and Carroll Counties. Bitumen deposits are present in Mississippian and Pennsylvanian limestone beds. The recoverable oil of 24–28° API gravity at depth in the northern parts of the area changes to highly viscous, low-gravity oil in the southern parts toward the outcrop of the reservoir rocks.—*from* Authors' abstract

West, Philip W. *See* Ramakrishna, T. V. 03649

Wheeler, G. V. *See* Woodriff, R. A. 03277

Whetten, J. T. *See* Knebel, H. J. 03567

03850 **White, James A. L.** Native sulfur deposits associated with volcanic activity: Mining Eng., v. 20, no. 6, p. 47–51, illus., table, 1968.

Sulfur deposits associated with all phases of volcanic activity are found worldwide but are concentrated around the Pacific "Ring of Fire" and are usually associated with porous, fractured stratovolcanic rocks of intermediate composition which have been subjected to a protracted fumarolic or solfataric stage in Pleistocene or Recent time. The three basic modes of emplacement are gaseous (fumarolic), aqueous (hot spring), and liquid or molten flow. Deposits may occur in the volcanic center, on the volcanic flanks, in associated faults, in associated hot springs, and in areas of alluvial deposition (detrital deposition). The most common forms of mineralization are fine-grained sulfur, marcasite, and(or) pyrite disseminated through bleached ash. Minor amounts of other epithermal minerals are commonly present. Tonnage-wise, most volcanic sulfur deposits are small and uneconomic.—MAC

White, R. J. *See* Webb, J. B. 03485

03674 **Whitney, Marion Isabelle; Brewer, Helene B.** Discoveries in aerodynamic erosion with wind tunnel experiments: Michigan Acad. Sci., Arts and Letters Papers 1967, v. 53, p. 91–104, illus., 1968.

Dune corridors in Big Sable Point, Mason County, Mich., have yielded ventifacts of carbonate rocks, and of a few other types of rock and insoluble substances, bearing rilled facets (rillensteine); these rills differ from solution rills and are destroyed by sandblast. Observations in other ventifact areas, wind-tunnel and other laboratory experiments on airflow, and controlled outdoor exposure tests on natural ventifacts and artificial models, have revealed that turbulent air, not grain impact, is the dominant eroding factor in production of rillensteine, and that ion and electron bombardment produce similar erosive effects on a much smaller scale. Each surface roughness causes the air striking it to become turbulent, with vacuum effect, producing microscopic helical scorings that coalesce into striae along pressure gradients to form rillensteine.—VMJ

03647 **Wiersma, Lawrence D.; Lott, Peter F.** Glyoximes as reagents for the gravimetric determination of bismuth [with French and German abs.]: Anal. Chim. Acta, v. 40, no. 2, p. 291–298, illus., tables, 1968.

Several oximes were investigated for possible use as organic precipitating reagents for bismuth. Of the oximes studied, nioxime (1,2-cyclohexanedionedioxime) was found to be an excellent gravimetric reagent for 50–500 mg of bismuth. The precipitation of bismuth was carried out in the presence of EDTA at pH 12 in aqueous solution; EDTA was used simultaneously as a masking agent for specificity and to prevent the formation of bismuth hydroxides. Bismuth could be determined in the presence of over 30 cations including Ni and Pd. The determination of lead nioximate was briefly studied.—Authors' summary

Williams, B. P. J. *See* Dineley, D. L. 03246

03577 **Williams, E. G.; Bergenback, R. E.; Weber, J. N.** Relationship between paleotopography and the thickness and geochemistry of a Pennsylvanian freshwater limestone: Jour. Sed. Petrology, v. 38, no. 2, p. 501–509, illus., tables, 1968.

Paleogeographic reconstruction in parts of the Carboniferous of western Pennsylvania have shown that an average paleoslope of three feet per mile is sufficient to markedly affect the thickness, continuity, and geochemistry of a freshwater limestone. Compared to limestones deposited on topographic highs, those deposited in lower areas are thinner, more discontinuous, contain greater amounts of siderite and dolomite, lesser amounts of calcite, and have more negative δC-13 values. These differences are attributed to the sizes and depths of inferred lakes, factors which control rate of circulation and evaporation.—Authors' abstract

Williams, G. K. *See* Tanner, W. F. 03462

03609 **Williams, Sidney A.** Wickenburgite, a new mineral from Arizona [abs.]: Canadian Mineralogist, v. 9, pt. 4, p. 582, 1968.

03761 **Williams, Sidney A.** Complex silver ores from Morey, Nevada: Canadian Mineralogist, v. 9, pt. 4, p. 478–484, illus., tables, 1968.

Silver ores at Morey occur as kryptothermal fracture fillings cutting a nevadite intrusive. Gangue minerals are rhodochrosite, quartz, pyrite, and arsenopyrite. The major silver minerals are diaphorite, owyheeite, andorite, pyrargyrite, and stephanite. Jamesonite and sphalerite are also abundant. Owyheeite, the most important ore mineral, has formed at the expense of andorite via a complex series of replacements. Single crystals of diaphorite, fizelyite, and owyheeite have been studied goniometrically. Diaphorite has been confirmed as monoclinic 2/m with $\beta = 90°5'$, a:b:c = 2.6900:1:5.4024 or, after transformation to new axes, $\beta = 116°27.5'$, a:b:c = 2.6900:1:3.0172. Ten forms are reported for owyheeite and the axial ratio is a:b:c = 0.840:1:0.312. One fizelyite crystal showed eight forms and gave a:b:c = 0.703:1:0.458.—*from* Author's abstract

Willis, Eric H. *See* Buckley, James D. 03794

03278 **Willis, J. B.** Some properties of nitrous oxide-supported flames [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 359, 1968.

Willson, Robert G. *See* Gathright, Thomas M. 03524

03579 **Wilson, Charles W., Jr.; Tiedemann, Herbert A.** Mineral resources summary of the Ellis Mills quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 6 p., 1968.

Minor amounts of iron ore were mined or prospected at three localities in the Ellis Mills quadrangle about 100 years ago; deposits are on or near crests of ridges or ridge spurs. Sand and gravel resources include alluvial material in flood plains and higher level alluvial deposits of creeks and larger tributaries. Although there are no quarries, the Warsaw, St. Louis, and Ste. Genevieve Limestones contain stone acceptable for most general uses. It is possible that small amounts of chert have been removed from the area. This text accompanies Tennessee Div. Geology Geol. Map GM 38-SE by C. W. Wilson, Jr., R. G. Stearns, and H. A. Tiedemann (cited separately).—MCM

03580 **Wilson, Charles W., Jr.; Russell, Ernest E.** Geologic map of the Poplar Creek quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 19-SE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Poplar Creek quadrangle, Tennessee," by C. W. Wilson, Jr. is cited separately.—MCM

03582 **Wilson, Charles W., Jr.; Barnes, Robert H.; Tiedemann, Herbert A.** Mineral resources summary of the Needmore quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 8 p., table, 1968.

Mineral resources mined in the Needmore quadrangle are iron ore (before or shortly after the Civil War) and limestone. Iron deposits (mostly small) are on or near crests of ridges or ridge spurs. Limestone has been quarried at two places; the Warsaw and St. Louis Limestones contain stone acceptable for most uses. Potential resources are chert and sand and gravel. This summary accompanies Tennessee Div. Geology Geol. Map GM 38-NE by R. G. Stearns, H. A. Tiedemann, and C. W. Wilson, Jr. (cited separately).—MCM

03583 **Wilson, Charles W., Jr.; Tiedemann, Herbert A.** Mineral resources summary of the Erin quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 8 p., 1968.

Mineral resources mined in the Erin quadrangle are limestone, iron ore, chert, and gravel. The Knox Dolomite is the only good source of dolomite, whereas limestone of the Stones River Group, and the Laurel, Lego, Decatur, Warsaw, St. Louis, and Ste. Genevieve limestones are all acceptable for most uses. Iron ore is known to have been mined or prospected at three localities but no mining or systematic prospecting has been done for many years. One active chert pit is in residuum of the Fort Payne Formation. Possible sources of sand and gravel include alluvial material in channels, flood plains, and higher level alluvial deposits of larger creeks. This summary accompanies Tennessee Div. Geology Geol. Map GM 38-SW by R. G. Stearns, H. A. Tiedemann, and C. W. Wilson, Jr. (cited separately).—MCM

03585 **Wilson, Charles W., Jr.** Mineral resources summary of the Gassaway quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 10 p., tables, 1968.

Of the several limestone formations exposed in the Gassaway quadrangle, the Carters, Bigby–Cannon, Warsaw, St. Louis, and Monteagle are best suited for most general uses. Fluorite, barite, galena, and sphalerite occur and have been prospected extensively but have not been mined. Small amounts of gravel have been dug from creek bars, and a potential resource is chert which is abundant in residuum from the Fort Payne Formation. This summary accompanies Tennessee Div. Geology Geol. Map GM 323-NW by R. H. Barnes and C. W. Wilson, Jr. (cited separately).—MCM

Wilson, Charles W., Jr. *See* Taylor, Landon C. 03586

Wilson, Charles W., Jr. *See* Taylor, Landon C. 03587

Wilson, Charles W., Jr. *See* Taylor, Landon C. 03588

03610 **Wilson, Charles W., Jr.** Mineral resources summary of the Poplar Creek quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 4 p., 1968.

Mined mineral resources in the Poplar Creek quadrangle are chert of the Fort Payne and Camden Formations and gravel in fluvial deposits. A potential resource is sand. This summary accompanies Tennessee Div. Geology Geol. Map GM 19-SE by C. W. Wilson, Jr. and E. E. Russell (cited separately).—MCM

03611 **Wilson, Charles W., Jr.** Mineral resources summary of the Sugar Tree quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 5 p., 1968.

Mined mineral resources of the Sugar Tree quadrangle are (1) limestone—best sources, Decatur Limestone and overlying Rockhouse Limestone Member of the Ross Formation; (2) chert of the Camden and Harriman Formations, and possibly from the Fort Payne Formation; and (3) gravel in flood plains and beds of larger streams and in remnants of higher level fluvial deposits. Sand is a potential resource. This text accompanies Tennessee Div. Geology Geol. Map GM 21-SE by C. W. Wilson, Jr. and E. E. Russell (cited separately).—MCM

03701 **Wilson, Charles W., Jr.; Russell, Ernest E.** Geologic map of the Sugar Tree quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 21-SE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Sugar Tree quadrangle, Tennessee," by C. W. Wilson, Jr. is cited separately.—MCM

03702 **Wilson, Charles W., Jr.** Geologic map of the Perryville quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 22-SE, scale 1:24,000, separate text, 1968.

Mineral resources mined in the Perryville quadrangle are chert, sand and gravel, limestone, iron ore, and phosphate. The Harriman and Fort Payne Formations are the sources of chert, the former having potential for high-silica content. Sand and gravel occur in alluvial deposits on flood plains and in older alluvial deposits above present flood plain levels. Best sources of limestone are the Decatur, Rockhouse, Lego, Laurel, and Bob Limestones. The most important concentrations of iron are in the lower few feet of the Fort Payne Formation. High-grade white phosphate occurs as angular and irregularly shaped chunks ranging up to boulder-size disseminated in soil that fills cutters in the Rockhouse Limestone Member of the Ross Formation or the Decatur Limestone.—MCM

03703 **Wilson, Charles W., Jr.** Geologic map of the Jeannette quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 22-NE, scale 1:24,000, separate text, 1968.

The accompanying text on mineral resources of the Jeannette quadrangle examines the limestone deposits (Decatur and Rockhouse Limestones); chert in the Camden, Harriman, and Fort Payne Formations; tripoli derived from siliceous limestone of the Fort Payne Formation; sand and gravel in alluvial deposits; and white phosphate in the Rockhouse Limestone Member of the Ross Formation and the Decatur Limestone.—MCM

03705 **Wilson, Charles W., Jr.; Stearns, Richard G.; Tiedemann, Herbert A.** Geologic map of the Ellis Mills quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 38-SE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Ellis Mills quadrangle, Tennessee," by C. W. Wilson, Jr. and H. A. Tiedemann is cited separately.—MCM

Wilson, Charles W., Jr. *See* Stearns, Richard G. 03706

Wilson, Charles W., Jr. *See* Stearns, Richard G. 03707

03709 **Wilson, Charles W., Jr.** Geologic map of the Liberty quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 322-SW, scale 1:24,000, separate text, 1968.

Mineral resources described in the accompanying text are limestone from the Carters and Bigby-Cannon (best suited for most general uses), and gravel from creek bars for use as road metal. Chert is abundant in the Fort Payne Formation and could be used for fill material and for surfacing secondary roads.—MCM

Wilson, Charles W., Jr. *See* Barnes, Robert H. 03710

Wilson, Charles W., Jr. *See* Barnes, Robert H. 03711

03712 **Wilson, Charles W., Jr.; Marcher, Melvin V.** Geologic map of the Cookeville West quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 326-NE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Cookeville West quadrangle, Tennessee," by L. C. Taylor and C. W. Wilson, Jr. is cited separately.—MCM

03713 **Wilson, Charles W., Jr.; Colvin, John M., Jr.** Geologic map of the Hilham quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 330-NW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Hilham quadrangle, Tennessee," by L. C. Taylor and C. W. Wilson, Jr. is cited separately.—MCM

03913 **Wilson, R. L.** Reply [to discussion by Larson and Strangway of "Correlation of petrology and natural magnetic polarity in Columbia Plateau basalts" (1967)]: Royal Astron. Soc. Geophys. Jour., v. 15, no. 4, p. 443-447, illus., 1968.

Wilson discusses two particular points made by Larson and Strangway in their criticism (ibid., p. 437-441); the first concerns the statistical breakdown of the data and the second their misunderstanding of the conclusions in the paper in question. Wilson and Watkins never claimed that the oxidation state is controlled by the magnetic field polarity, and would be very much surprised if it were true. They merely stated that a "causal connection, *however indirect*, between field polarity and oxidation states in lavas would permit the evidence to be reconciled."—DBV

Winefordner, J. D. *See* Mansfield, J. M. 03651

03316 **Wing, James; Wahlgren, M. A.** Some analytical applications of high intensity Am-Cm-Be isotopic neutron sources [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 369, 1968.

03515 **Winn, Vernard.** Worsham gas field, Reeves County, Texas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1389-1393, illus., 1968.

The first significant gas discovery from sandstone of the Bell Canyon Formation in the Delaware basin was the Worsham field; prior production from this formation had been predominantly oil. The entrapment in the Worsham field is mainly structural, whereas stratigraphy appears to be the controlling factor in other Bell Canyon fields.—Author's abstract

03265 **Winterer, Edward L.** Tectonic erosion in the Roberts Mountains, Nevada: Jour. Geology, v. 76, no. 3, p. 347-357, illus., 1968.

The upper plate of the Roberts thrust, developed in middle Paleozoic time, was fragmented in Late Jurassic or Early Cretaceous time and in part reshuffled with fragments of the lower plate. The movement was by gravity sliding radially off a broad structural dome perhaps developed by a still-covered intrusive. Pore-water pressure from water mobilized by the magma may have facilitated the sliding.—REW

03787 **Withrow, Philip C.** Depositional environments of Pennsylvanian Red Fork Sandstone in northeastern Anadarko Basin, Oklahoma: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1638–1654, illus., 1968.

The Pennsylvanian Red Fork Sandstone, which produces oil and gas, was deposited west of the Nemaha ridge during the time Cherokee deposition (Desmoinesian) in the large Enid embayment. There were four fairly distinct phases of sand deposition: an early phase during which channel sand was deposited, two phases of offshore-bar deposition, and a brief period when seas receded from the area and channel sand was deposited. By reconstruction of the depositional environments of the Red Fork Sandstone and by interpretation of this unit as representing four fairly distinct phases, the Red Fork is shown to be a reservoir with great potential in the Anadarko basin.—*from* Author's abstract

03729 **Wolfe, John.** Earthquake history near Lake Tahoe, *in* Geologic studies in the Lake Tahoe area—Geol. Soc. Sacramento, Ann. Field Trip Guidebook, 1968: Sacramento, Calif., Geol. Soc. Sacramento, p. 27–36, illus., tables, 1968.

Earthquake activity in the Sierra Nevada Range is not widespread but is restricted to areas along the eastern edge, such as the Tahoe region. The activity has been moderate since historic time with most of the shocks to the north and northeast of the lake. A table lists those significant quakes occurring before 1934 which was before instrumentally recorded and determined quakes were published. Some had an intensity of IX by the Rossi–Forel scale. Since 1930 the maximum intensity has not exceeded VI on the Modified Mercalli scale. Earthquakes from 1934 to 1966 are listed in a table, and 35 of magnitude of 4.0 or greater are shown on a map.—HRC

03498 **Woncik, John.** Kinta gas field, Haskell County, Oklahoma, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1636–1643, illus., 1968.

The Kinta gas field is in the northern shelf area of the Arkoma basin where production is from the Pennsylvanian Spiro and Cromwell Sands. Anticline structure is present, but the trap appears to be stratigraphic, due largely to porosity changes. The porosity is due to erratic sandstone deposition. The area is cut by normal "growth" faults which show a greater deposition of Atoka sediments on the down side. Water sands are present in the Spiro and Cromwell north of the Mulberry fault in Haskell County, and south of the fault gas generally is found where these sandstone units are porous.—*from* Author's abstract

03925 **Wong, J. Y.; Linde, R. K.; DeCarli, P. S.** Dynamic electrical resistivity of iron—Evidence for a new high pressure phase: Nature, v. 219, no. 5155, p. 713–714, illus., 1968,

A re-investigation of the response of α-iron to shock loading has provided data that are in disagreement with the phase transition results obtained by Fuller and Price (1962). The possible existence of a new dynamic phase transition in iron is reported. The present dynamic high-pressure resistivity data for iron show a sudden increase (about 30 percent) in the resistance at 80 kbar which is absent in the data of Fuller and Price. Three mechanisms are considered as possible causes: (1) The α transition might actually start at a lower pressure than has been previously reported; (2) a shock-induced resistivity increase caused by creation of lattice defects could account for some rise; (3) it is possible that at least part of the α-iron is transformed to a new phase under influence of very high shear stresses associated with the shock.—KAF

03770 **Woodburne, Michael O.** The cranial myology and osteology of *Dicotyles tajacu*, the collared peccary, and its bearing on classification: Southern California Acad. Sci. Mem., v. 7, 48 p., illus., tables, 1968.

The cranial myology of the collared peccary is described with emphasis on the facility with which muscle attachments are determinable from remnant scars on the cleaned crania; the cranial and dental osteology is compared with that of the white lipped peccary. The two broad groups, represented by the white lipped peccary, whose

lineage came from the late Pleistocene of North America, and the collared peccary, whose antecedents are found in the late Pleistocene of Brazil, seem to have been separate entities since early Pliocene time. The morphological distinctions between the two groups have historical significance and it is concluded that two separate genera are represented. The collared peccary is *Dicotyles tajacu* (Linnaeus, 1758); the white lipped peccary is *Tayassu pecari* Fischer, 1814.—*from* Author's abstract

03277 **Woodriff, R. A.; Wheeler, G. V.; Ryder, W. A.** Hollow-cathode lamp for use in emission and absorption: Appl. Spectroscopy, v. 22, no. 4, p. 348–349, illus., 1968.

Demountable hollow-cathode lamps have frequent application as sample emission sources in high resolution spectroscopy and as light emission sources in atomic absorption spectrometry. Several desirable features are listed, and a lamp designed to meet these requirements is illustrated and described.—ESL

03310 **Woodriff, Ray; Stone, Ronald W.** Electrothermal atomization for atomic absorption analysis [abs.]: Appl. Spectroscopy, v. 22, no. 4, p. 368, 1968.

03785 **Woodward, Lee A.** Lower Cambrian and Upper Precambrian strata of Beaver Mountains, Utah: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 7, p. 1279–1290, illus., 1968.

Cambrian Prospect Mountain Quartzite and seven underlying units, tentatively considered Precambrian, are mapped in the Beaver Mountains. Assigned to the Precambrian is 5,145 feet of slate, argillite, marble, metasiltstone, quartzite, and conglomerate, which have undergone very low-grade regional metamorphism. The uppermost Precambrian unit, a purple conglomeratic quartzite, is correlated with the Mutual Formation of north-central Utah. The overlying tan and pink Prospect Mountain Quartzite is at least 4,000 feet thick. Correlation of the Beaver Mountains section with strata from the Canyon Range, central Utah, is established. Tentative correlations, with late Precambrian McCoy Creek Group of eastern Nevada and western Utah are suggested.—*from* Author's abstract

03626 **Worzel, J. Lamar.** Advances in marine geophysical research of continental margins, *in* Symposium on continental margins and island arcs, 3d, Zurich, 1967: Canadian Jour. Earth Sci., v. 5, no. 4, pt. 2, p. 963–983, illus., 1968.

Geophysical data available for the continental margins of North America, South America, Africa, and Europe are examined and summarized. Seismic reflection profiling provides much detail of the uppermost sedimentary cover; seismic refraction data delineate the broad outlines of the upper crustal layers; and gravity data restrict the choices of the deep crustal structure and that of the upper mantle. The transition zone between continental and oceanic structure is restricted to a narrow zone varying between 50 km and 300 km in width, localized in the region of the 2,000 m isobath, for various coasts. The continental margins are generally in isostatic equilibrium as a whole, although departing from this equilibrium somewhat, especially in the transition zone.—*from* Author's abstract

Wyllie, P. J. *See* Boettcher, A. L. 03263

Wyllie, P. J. *See* Lambert, I. B. 03926

Wyllie, P. J. *See* Boettcher, A. L. 03937

03696 **Wyrick, Granville G.** Ground-water resources of the Appalachian region: U.S. Geol. Survey Hydrol. Inv. Atlas HA-295, 4 sheets, scale about 1 in. to 50 mi., text, 1968.

The four sheets contain the following: (1) a geologic map and bibliography, (2) maps showing geologic features favoring ground-water occurrence and ground water discharge, (3) maps indicating maximum yields of wells and costs of well fields yielding 1 mgd, and (4) maps showing cost of ground water and optimum ground-water development at computed costs. The most significant, highly permeable, unconsolidated rock units are those resulting from glaciation. Ground water may

be obtained from wells in consolidated rocks of every county with yields ranging from less than five to more than 1,000 gpm.—MCM

Young, Myron. *See* Dooley, John A. 03319

03499 **Young, Robert T.** Hardtner field, Barber County, Kansas, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1566–1569, illus., 1968.

The Hardtner field, in south-central Barber County, Kansas, was discovered in 1954. Two zones are productive, the "Conglomerate Sand" (Pennsylvanian) and the Mississipian "Chat". Trapping is stratigraphic. Cumulative gas production at the end of 1963 was about 75 billion cu ft, and remaining reserves were 75 billion cu ft.—Author's abstract

03886 **Zeizel, Arthur J.** The hydrogeologist's responsibility—Metropolitan water resources planning: Am. Geophys. Union Trans., v. 49, no. 3, p. 543–547, 1968.

As the population of the United States is changing from a predominantly rural to an urban society, so the traditional role of the hydrogeologist is changing. Needs for his services are reflecting the requirements of comprehensive water resource management programs. This trend toward urbanization is also creating new, complex water problems and related land problems. Comprehensive water resource planning offers a means of solving these problems and improving the living environment. Its emphasis is on alternative management measures that can best be planned and evaluated by interdisciplinary study teams, teams that should include the hydrogeologist. The inadequate communication that now exists between the hydrogeologist and the planner can be improved by a closer working relationship.—Author's abstract

03571 **Zenger, Donald H.** Determination of calcite and dolomite composition using the air comparison pycnometer: Jour. Sed. Petrology, v. 38, no. 2, p. 373–377, illus., tables, 1968.

Many methods have been used to analyze carbonate rocks for calcite-dolomite content. One approach is based on difference in density of the two minerals. In this study, volumes of about 50-gm samples of carbonates are determined with an air comparison pycnometer, and densities calculated. The precision (standard deviation) of the determination is 0.0028. Replicate weighings, volume determinations, and density calculations are done within five minutes. Calcite dolomite composition is found by reference to a calibration line constructed with calcite and dolomite as end members. The 95 percent confidence interval for an analysis is two percent. The density contributions of terrigenous material present should be taken into account. This method is sufficiently precise and accurate for most purposes. It has, in addition, the advantage of being simple, very rapid, and relatively inexpensive.—Author's abstract

Zietz, Isidore. *See* Taylor, Patrick. 03812

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